THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. IX. APRIL, 1898. NO. 3.

GROWTH OF CHILDREN IN HEIGHT AND WEIGHT.*

By FREDERIC BURK,
Fellow in Psychology, Clark University.

For the past few years the province of psychology has been rapidly extending. While tradition has sought by means of definitions and classifications, epistemological or ontological, to maintain sharply defined limits, nevertheless practical thought and investigation have done and are doing much to break down these formal barriers, as we realize when we turn from our Sir William Hamilton to Wundt, from Bain to Lloyd Morgan, from McCosh to James. This does not necessarily mean that the past is wrong, but it at least signifies

*A bibliography will be found at the conclusion, numbered and in alphabetical order. The names of all contributors mentioned in the text will be found in this bibliography. In cases where one individual has contributed more than one article, or confusion for any other reason may be possible, the bibliography number will be found in the text as a means of readier reference. For page references a dagger (†) will indicate that the page number will be found as a footnote.

This article constitutes the preliminary first part to a general review of the studies which have been made upon the physical and mental development of children during the years usually spent in the common schools, more particularly the primary school. It aims (1) to present the salient facts from these studies rather than to draw general conclusions; and (2) to serve those who have occasion to investigate these fields as a pathfinder to sources of information. Dealing with the child only to the end of his common school period, this review touches upon the phenomena of adolescence only incidentally. President G. Stanley Hall's book upon adolescence, shortly forthcoming, will review exhaustively not only the adolescent field, but also will treat in a larger philosophic way the general principles of growth and development.—F. B.

that psychology is growing, that the present is bigger than the past, that there is in modern investigation a spirit seeking organic relations which the formalism of old conceptions is powerless to withstand. Any systematic study of genetic psychology at the present juncture begins with the phenomena of physical growth. Not that up to this time a code of definite principles of growth has been formulated, but the dominant tendency of modern mental science has been to correlate more closely the mental and physical. Definite and final conclusions showing the exact and specific relations of this element to that are hardly matured, but a large number of investigations have been made, and for proper orientation towards educational problems of the present, the educator must have acquaintance with the trend of these investigations. Some bold attempts have been made to strike out direct relations between mental capacity and forms of physical growth, as, for example, Dr. Porter, from an examination of St. Louis children, concludes that the taller and heavier children at a given age are, on the average, mentally brighter. While perhaps we may be yet far from definite conclusions upon any of these problems, it is clear that the numerous studies suggesting the dependence of mental development, through physical development, upon age, nutrition, race, sex, climate, height, weight, etc., necessarily form the logical starting point of a pedagogical study of children.

We shall commence, therefore, with a review of the studies upon growth in height and weight, and later consider various other elements which have been put forth as conditioning factors of mental development. We have little data for growth from birth to six years,* for the reason, of course, that children in masses are not accessible until they go to school. We know very little of growth after the seventeenth or eighteenth year, for the same reason. Within the school ages, interest has centred largely upon pubertal growth, and the years from six to eleven or twelve have been somewhat neglected. Several attempts have been made to classify growth into periods. There is universal agreement that three periods are distinctly discernible — a period from birth to puberty, a period during the progress of pubertal changes, and a period after these changes; but attempts to break up these periods into smaller ones as yet lack general assent upon any exact basis of serviceable classification.

Vierordt (†[95]) divides growth into seven periods, as follows: first, suckling period, from birth to first teething in seventh or

*The most complete treatments of this period will be found by Camerer ([22, 23]), Daffner ([27, 28]), and Vierordt ([93, 94, 95]).

([95]) P. 601.

eighth month, in which the breathing, digestion and senses begin their specific activities; second, later child age to the second dentition, in seventh or eighth year; third, to puberty in fourteenth or fifteenth year; fourth, to complete development in height in twenty-first or twenty-second year; fifth, early adult age; sixth, later adult age to sixtieth year; seventh, old age. Liharzik somewhat arbitrarily divided the first twenty-five years of life into twenty-four periods. Zeissing (94) found three: first, one of decrease in the yearly increments of growth up to nine years; second, increase of yearly increments to the seventeenth year; and third, a later decrease. Hartwell (50) follows this division upon the physiological grounds that during the first period the brain practically completes its growth, and the child is sensory rather than motor. Axel Key (59) finds, first, a period 6 to 8 years of moderate annual increase; second, a period 9 to 13 years of least increase; third, a period 13 to 17 of greatest increase, and a period 17 to 19 of decreasing rate of increment. Combe makes two periods during school age: 7 to 10 and 14 to 17 in boys, and 7 to 12 and 12 to 15 in girls. Lange finds four periods: first, birth to 2 years, highest rate of growth; second, 2 to 12 years, decreasing annual increments; third, 12 to 15 years, mental growth; fourth, 15 to 21 years, a sudden decrease in annual increments.

The question of the point at which growth matures is one which has reached, as yet, no definite conclusion. Certainly there is no disagreement upon the fact that under normal conditions, no material increments of importance occur after the nineteenth year, though unquestionably there is increase of theoretical value up to the twenty-first or twenty-second year, if not until very much later. Growth in height certainly matures before growth in weight.

Quetelet (†80) put maturity at the 30th year in men, and 25th year in women. Beyer (9) thinks we must add at least an inch to the average height for growth after the 19th year. Roberts' tables would indicate a maturity in weight at 22 for men, and at 19 for women. Baxter (3) found an increase in stature in men up to the 35th year, though he places the average age of maturity earlier. Villerme puts the age of maturity in males at 23, and Liharzik at 25. The Report of Committee of Anthropometry (37) places the maturity in height of women at 20 years, and of men at 23 years.

STATURE.

The average length of new-born male infants has been generally taken as 50 centimeters (19.68 inches), and about one-half centimeter (approximately one-fifth of an inch) less for females (†94).

Other averages given by Vierordt (94) are as follows:

	Males.	Females.
Russow,	50 cm.	49.5 cm.
Quetelet,	50	49.4
Kézmarsky,	50.2	49.4
Fesser,	51.5	50.5
Wagner,	47.4	46.75
Roberts,	49.1	48.0

(80) P. 170. (94) P. 2.

The Anthropometric Committee ([37]) from 451 males and 466 females in the hospitals of London and Edinburgh gives the average as 19.52 inches for boys and 19.32 for girls. Out of the 451 males, 133 measured 20 inches, 116 measured 19 inches, and the limits were from 15 to 24 inches. In the case of females, the limits were from 16 to 23 inches, and of the 466 cases, 131 were 19 inches, 117 were 20 inches, and 109 were 18 inches.

Vierordt, quoting Fasbender, finds that the average first-born children are about .43 cm. shorter than later born. On the other hand, Boas([14]) finds that first-born children distinctly exceed later-born children in stature as well as weight from the 6th year to the 15th in males, and until the adult state in females.

During the first year the child grows at the most rapid rate of its entire life. The average increase is probably between seven and eight inches. The rate of growth decreases rapidly from month to month of the first year, and in general it may be said that the rate decreases with age. However, as will be pointed out, there are important fluctuations which modify this rule. There are no data from large numbers of children available by which to determine the growth nor its rate up to five or six yesrs.

Russow finds that in the first month of life the infant grows 12½ per cent. of its height; the rate steadily decreases and in the twelfth month is 3 per cent. D'Espine and Picôt (†[32]) give similar figures.

At one year of age, the child is on the average 70 to 75 cm. in length, showing an increase of about 50 per cent. for the first year. Russow ([94]) gives the length, at one year of age, as 73; Beneke, 70; Hahner, 75; Liharzik, 80 cm. ([94]) D'Espine and Picot give the lengths of each year as follows: first, 19.8 cm.; second, 9.0; third, 7.3; fourth, 6.4; fifth, 6; next ten years, 6 cm. Zeissing's lengths are as follows: 23.2, 10.6, 8.7, 7.5, 5.9, 6.6; Daffner ([27]), for boys, 21.9, 11.42, 6.56, 4.76, 6.34, 3.03,—for girls, 22.5, 12.11, 6.28, 6.49, 6.1, 4.3, 3.6.

The rate of growth in this early period, so far as data indicate, is practically the same for both sexes. Starting at birth slightly shorter than boys, the girls at six years of age are only a fraction of an inch shorter.

Roberts, 1.7 in.; Gilbert ([44]), .5 in.; Peckham, .3 in.; Oakland, .3 in. (girls taller); Danish ([51]), .0; Swedish ([58]), 1.2 in.; Geissler and Uhlitz, .3 in.; Porter, .5 in.; Geissler, .4 in.; Bowditch ([18]), .4 in.; Quetelet, .6 in.

Between 6 and 7 years of age, the average American child measures about 44 or 45 inches. This is an increase of 24 or 25 inches for the first six years of life, or about 43 per cent. of the length at birth. At 12 years of age American boys are on the average about 55 inches in height, an increase of 10 or 11 inches for the six preceding years; this amounts to an increase of about 20 per cent. or less of the height at 6 years—less than half the percentage rate for the first six years. Until

([32]) See, also, Reitz, "Grundzugie d. Therapie des Kindesalters," 1883, p. 22; Vierordt, "Daten u. Tabellen," p. 3.

10 to 12 years, there is no material difference between the heights of the sexes; but during these two years, varying with localities, the girls begin to grow faster than boys, and for the two or three years following are actually taller (Table A). During the 14th or 15th year, this rate materially slackens, and though girls grow slowly for two or three years longer, they have practically completed their growth in height, generally at the age of 15, as a glance at the tables of increases will show. The rate of accelerated growth in height, in the case of boys, begins during the period 12 to 14 as a rule. Boys are slower in reaching their maximum rate and therefore grow rapidly a longer time. They overtake the girls usually in the 15th year, and by the end of the 16th year or later, their period of accelerated rate ends. Until the 11th year or thereabouts, as stated, there is no material difference in the height of the two sexes. We have therefore to consider two distinct periods in the growth of an individual: first, the period before the rapid acceleration sets in until the 11th or 12th year in girls and the 13th or 14th in boys; secondly, the period after this accelerated rate sets in until maturity. The first period of growth includes that of the first five or seven years in school.

If now we glance at Table A of heights, taking, for example, the larger American studies of Bowditch, Peckham and Porter, we see that the rate of growth is somewhat rapid in the beginning, the 6th or 7th year, and decreases with fluctuations until about 10 years in girls and 12 years in boys, when the prepubertal acceleration sets in. This general decrease is to be observed in the case of all larger studies, though the year of the beginning of the prepubertal increase varies a year or so. The same decrease in rate from six years up to the time of the prepubertal increase is to be observed similarly in the case of girls. Curves constructed from absolute annual increases show, as a rule, in this childhood period one or two pronounced fluctuations, but they do not occur with a regularity in all charts sufficient to be of assurance that their cause is certainly physiological and not merely statistical. Nevertheless it will be observed that the curves are by no means regular. Growth seems to be by rapid increases followed by resting periods, by fits and starts as it were.

Gilbert ([44]) and Peckham have called attention to one such fluctuation, a decrease of rate in the 8th or 9th year, and suggest as a cause the second dentition.* Vierordt (†[95]) makes the second den-

* Camerer's curves ([27]) show very conclusively a halting ofgrowth at the first dentition in infancy, and he unqualifiedly recognizes this cause.

([95]) P. 601.

tition a physiological division line between two periods of childhood. Hartwell (†[50]) makes a physiological period end in 7th or 8th year, since the brain practically completes its growth at this period. This would seem to suggest a possible resting period for the bodily development.

On the whole, in the absence of any determinative data upon exact details, it is perhaps safer to regard the period from 6 years to the prepubertal increase as a general decrease in the rate of growth with one or two minor fluctuations. The investigations of Combe, Landsberger and Carstadt, made upon a comparatively small number of children, but more upon the plan of individual measurements, tracing the growth of individual children for a number of years, justifies this view.

If we subtract the average height at 6 years from the average height at 12 years for boys, we obtain from each of the three large American investigations approximately the same increase for the 6 years: Boston, 11.4 in.; St. Louis, 11.5 in.; Milwaukee, 10.9 in. The increases of girls, owing to earlier appearance of the prepubertal acceleration, can be taken only from 6 to 10 years. These increments are as follows: Boston, 8 in.; St. Louis, 8.2 in.; Milwaukee, 8.1 in.

Combe, who estimated the annual increases by grouping children of the same age in months, concludes: "The increase in boys to 14 and in girls to 11 is very regular, and varies only about a millimeter more or less. The twelve curves, which represent the monthly averages, constitute a narrow bundle of almost always parallel and seldom crossing lines."

Landsberger in Posen says: "The average yearly increase in height during the school age (6 to 13) can be taken in all zones as between 4.5 to 5.5 cm. with some safety—for the first half somewhat greater and for the last half somewhat smaller." Of course, he makes a mistake in applying this rule to girls, who in many localities are in 13th year already reaching their maximum of acceleration.

West ([104]) says: "If we compare the mean differences between the general average and the averages for the six American cities (Boston, St. Louis, Milwaukee, Toronto, Worcester, Oakland) in weight and stature, we find that until about the 11th year the children develop with comparative uniformity, but from that age the modifying effects of descent and surroundings are beginning to act, causing the mean differences to increase very markedly."

TABLES AND CHARTS.—Table A gives the heights of children during the growing period. It is practically complete to date for the larger general investigations which have been made. In the originals of most of these the data have been given in centimeters, but these have been expressed in inches. In a study of them caution should be taken on a few matters. The extremes, those of the beginning or concluding ages in many cases, are based on a smaller number of measurements than the middle period. In some cases these doubtful averages have already been omitted. The figures of Dr. Porter for St. Louis are not comparable with the others, for the

([50]) P. 57.

Table A.

Showing the Stature at Successive Ages in Various Countries and Cities in inches.

Age.	Boston. (Bowd'h.)[18] 13,691 Boys. 10,904 Girls.		St. Louis. (Porter.)[78] 16,295 Boys. 18,059 Girls. Age nearest Birthday.		Milwaukee. (Peck'm.)[76] 4,773 Boys. 4,891 Girls.		Oakland.[75] Number not Stated.		Worcester. (West.)[47] 3,250 Children.		New Haven (Gilbert.)[44] About 50 of each sex for each age.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0												
1½												
2½												
3½												
4½					39.98	39.65						
5½	41.57	41 29			42.28	41.72			43.2	42.3		
6½	43.75	43.35	42.9	42.4	44.08	43.78	44.1	44.4	44.4	43.8	45.0	44.9
7½	45.74	45.52	44.9	44.5	46.09	45.93	45.0	44.9	46.1	46.3	47.1	46.9
8½	47.76	47.58	46.9	46.6	48.05	47.59	47.6	46.8	48.2	47.9	48.9	48.4
9½	49.69	49.37	49.0	48.7	50.00	49.81	49.3	49.2	50.0	49.8	51.2	50.8
10½	51.68	51.34	50.7	50.6	51.85	51.89	51.9	51.5	52.8	52.3	53.0	52.8
11½	53.33	53.42	52.7	52.4	53.76	53.8	53.5	53.9	54.6	53.9	55.9	54.6
12½	55.1	55.9	54.4	54.8	55.0	56.5	55.1	56.6	56.3	57.0	57.0	57.9
13½	57.2	58.2	56.3	57.7	57.5	58.7	56.8	60.0	58.1	58.2	58.8	60.4
14½	59.9	59.9	58.3	59.3	59.9	60.5	59.7	61.2	60.7	60.5	59.3	61.4
15½	62.3	61.1	61.0	61.0	62.3	61.6	61.8	61.9	63.9	61.8	62.8	62.5
16½	65.0	61.6	63.1	62.0	65.1	62.2	61.5	62.7	65.3	62.4	65.7	62.5
17½	66.2	61.9	65.0	62.7	66.6	62.9	67.1	62.7	66.3	62.8	67.1	63.6
18½	66.7	61.9		62.8		62.5	67.6	63.2	66.9	62.6		
19½				62.4					67.4	62.7		
20½									68.5	62.6		
21½									67.1	62.7		

Age.	Iowa. (Gilbert.)[45] About 50 of each sex for each age.		Pennsylv'a. (Hall.)[48] 2,434 Males (nude).		Moscow. (Erism'n)[31] 3,212 Boys. 1,495 Girls.		Sweden Com'ission. (Key.)[58] 15.000 Boys. 3,000 Girls.		Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls.		England. (Robe'ts.)[82] Over 10,000 Males.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0												
1½												
2½												
3½												
4½												
5½											41.2	
6½	45.0	44.6					45.6	44.5	44.1	44.1	43.2	
7½	47.8	46.8			44.1	43.9	47.6	45.7	45.3	45.3	45.0	
8½	49.6	49.2			46.4	45.8	49.6	48.4	47.2	47.2	47.0	
9½	51.3	51.3	51.2		48.3	47.1	51.6	50.0	49.2	49.2	49.2	
10½	53.3	53.0	53.9		51.5	49.2	52.4	52.0	51.2	51.2	50.5	
11½	55.2	54.5	55.1		53.4	51.1	53.5	53.9	53.1	52.4	51.5	
12½	57.1	58.0	56.7		55.2	52.3	55.1	56.3	54.3	54.3	53.0	
13½	58.7	59.2	61.0		57.2	54.5	56.7	58.3	56.3	57.5	55.9	
14½	61.7	61.7	62.3		59.1	57.4	58.7	60.2	58.7	59.4	57.8	
15½	64.7	63.3	65.3		61.6		61.4	61.8	61.4	60.6	60.7	
16½	66.7	63.3	66.5		63.5		63.8	62.6	64.6	62.6	62.9	
17½	68.2	64.5	67.1		64.6		65.7	63.0	65.7		64.5	
18½	68.6	64.6	67.3				66.9	63.0	66.9		65.5	
19½	69.0	64.6	67.5				67.3	63.8	66.9		66.0	
20½			67.6				67.7	63.0			66.3	
21½			67.7									

Age.	England. (Anthrop. Com.)[37] Over 30,000 Persons.		Belgium. (Quete't.)[80] Selected Ten of each Age and Sex.		Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls.		Lusanne. (Combe.)[35] 6,662 Measurements of 2,000 Children.		Freiburg. (Geissler-Uhlitsc'e)[42] 10,343 Boys. 10,830 Girls.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0			19.7	19.4						
1½			27.5	27.2						
2½			31.1	30.7						
3½	36.8	36.2	34.0	33.6	33.9	33.3				
4½	38.5	38.3	36.5	36.0	36.2	36.9				
5½	41.0	40.6	38.9	38.3	38.2	38.0				
6½	44.0	42.9	41.2	40.6	40.7	40.2			42.8	42.5
7½	46.0	44.5	43.5	42.8	44.3	43.0	46.2	45.8	44.3	44.1
8½	47.1	46.6	45.7	45.0	46.6	45.5	48.2	47.7	46.3	45.9
9½	49.7	48.7	48.0	47.1	48.8	47.6	50.0	49.5	48.1	47.8
10½	51.8	51.1	50.1	49.2	49.8	50.1	51.7	51.6	49.6	49.6
11½	53.5	53.1	52.2	51.2	50.9	51.7	53.3	53.7	51.4	51.6
12½	55.0	56.7	54.1	53.2	52.6	53.8	55.0	55.9	53.3	53.3
13½	56.9	57.8	56.0	55.1	55.0	56.1	56.9	57.9	55.2	55.7
14½	59.3	59.8	57.8	56.9	57.2	58.9				
15½	62.2	60.9	59.6	58.6	59.8	60.1				
16½	64.3	61.7	61.2	59.9	62.2	60.6				
17½	66.2	62.5	62.8	60.9	63.0	61.0				
18½	67.0	62.4	64.2	61.5	63.3	61.0				
19½	67.3	62.8	65.2	61.8	63.7					
20½	67.5	63.0	65.7	62.0						
21½	67.6	63.0								

TABLE A.

Showing the Stature at Successive Ages in Various Countries and Cities in inches.

...aven ...rt.)[44] ... 50 of ...ex for ...age.	Iowa. (Gilbert.)[45] About 50 of each sex for each age.		Pennsylv'a. (Hall.)[48] 2,434 Males (nude).		Moscow. (Erism'n)[31] 3,212 Boys. 1,495 Girls.		Sweden Com'ission. (Key.)[58] 15,000 Boys. 3,000 Girls.		Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls.		England. (Robe'ts.)[82] Over 10,000 Males.		England. (Anthrop. Com.)[37] Over 30,000 Persons.		Belgium. (Quete't.)[80] Selected Ten of each Age and Sex.		Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls.		Lusanne. (Combe.)[35] 6,662 Measurements of 2,000 Children.		Freiburg. (Geissler-Uhlitsc'e)[42] 10,343 Boys. 10,830 Girls.		Gohlis. (Geissler)[43] 1,386 Boys. 1,420 Girls.		Breslau. (Carsta't)[24] 4,274 Measurements of 600 Boys.		Posen. (Landsberger.)[63] 37 to 104 Boys for Seven Yrs.		Hamburg. (Kotelman.)[60] 515 Boys.		Radom. (Suligowski.)[88] 1,133 Boys.		Saalfeld. (Schmidt)[85] 4,699 Boys. 4,807 Girls.	
F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F	M.	F.	M.	F.	M.	F.
															19.7	19.4																		
															27.5	27.2																		
															31.1	30.7																		
													36.8	36.2	34.0	33.6	33.9	33.3																
													38.5	38.3	36.5	36.0	36.2	36.0																
											41.2		41.0	40.6	38.9	38.3	38.2	38.0																
44.9	45.0	44.6					45.6	44.5	44.1	44.1	43.2		44.0	42.9	41.2	40.6	40.7	40.2			42.8	42.5	43.4	43.0	43.0		42.1						43.0	42.7
46.9	47.8	46.8			44.1	43.9	47.6	45.7	45.3	45.3	45.0		46.0	44.5	43.5	42.8	44.3	43.0	46.2	45.8	44.3	44.1	45.0	44.8	44.8		44.2						45.0	44.9
48.4	49.6	49.2			46.4	45.8	49.6	48.4	47.2	47.2	47.0		47.1	46.6	45.7	45.0	46.6	45.5	48.2	47.7	46.3	45.9	47.0	46.3	46.8		46.2						47.2	46.6
50.8	51.3	51.3	51.2		48.3	47.1	51.6	50.0	49.2	49.2	49.2		49.7	48.7	48.0	47.1	48.8	47.6	50.0	49.5	48.1	47.8	48.8	48.8	48.7		48.1		50.6		49.6		49.2	48.8
52.8	53.3	53.0	53.9		51.5	49.2	52.4	52.0	51.2	51.2	50.5		51.8	51.1	50.1	49.2	49.8	50.1	51.7	51.6	49.6	49.6	50.8	50.6	50.6		49.4		51.5		51.1		50.5	50.9
54.6	55.2	54.5	55.1		53.4	51.1	53.5	53.9	53.1	52.4	51.5		53.5	53.1	52.2	51.2	50.9	51.7	53.3	53.7	51.4	51.6	52.1	52.7	52.5		51.2		53.2		52.7		52.3	52.6
57.9	57.1	58.0	56.7		55.2	52.3	55.1	56.3	54.3	54.3	53.0		55.0	56.7	54.1	53.2	52.6	53.8	55.0	55.9	53.3	53.3	54.4	54.9	54.4		53.2		55.1		54.1		54.3	54.6
60.4	58.7	59.2	61.0		57.2	54.5	56.7	58.3	56.3	57.5	55.9		56.9	57.8	56.0	55.1	55.0	56.1	56.9	57.9	55.2	55.7	55.4	57.1	56.4		55.1		56.3		56.5		56.0	56.8
61.4	61.7	61.7	62.3		59.1	57.4	58.7	60.2	58.7	59.4	57.8		59.3	59.8	57.8	56.9	57.2	58.9							58.7				58.6		58.7			
62.5	64.7	63.3	65.3		61.6		61.4	61.8	61.4	60.6	60.7		62.2	60.9	59.6	58.6	59.8	60.1							61.7				60.7		61.5			
62.5	66.7	63.3	66.5		63.5		63.8	62.6	64.6	62.6	62.9		64.3	61.7	61.2	59.9	62.2	60.6							64.1				63.7		63.5			
63.6	68.2	64.5	67.1		64.6		65.7	63.0	65.7		64.5		66.2	62.5	62.8	60.9	63.0	61.0											65.7		65.2			
	68.6	64.6	67.3				66.9	63.0	66.9		65.5		67.0	62.4	64.2	61.5	63.3	61.0											66.3		65.5			
	69.0	64.6	67.5				67.3	63.8	66.9		66.0		67.3	62.8	65.2	61.8	63.7												65.7		65.3			
			67.6				67.7	63.0			66.3		67.5	63.0	65.7	62.0													65.8		66.4			
			67.7										67.6	63.0																	65.7			

Table B.

Showing the Absolute Annual Increases in Height: Obtained by Subtracting the Successive Ages in Table A (inches).

Age.	Boston. M.	Boston. F.	St. Louis.* M.	St. Louis.* F.	Mil-wauk'e. M.	Mil-wauk'e. F.	Oak-land. M.	Oak-land. F.	Wor-cester. M.	Wor-cester. F.	New Haven. M.	New Haven. F.	Iowa. M.	Iowa. F.	Penn. M.	Penn. F.
0½— 1½																
1½— 2½																
2½— 3½																
3½— 4½																
4½— 5½					2.3	2.1										
5½— 6½	2.2	2.1			1.8	2.1			1.2	1.5						
6½— 7½	2.0	2.2	2.0	2.1	2.6	2.2			1.7	2.5	2.1	2.0	2.8	2.2		
7½— 8½	2.0	2.1	2.0	2.1	1.4	1.7	2.6	1.9	2.1	1.6	1.8	1.5	1.8	2.4		
8½— 9½	1.9	1.8	2.0	2.1	2.0	2.2	1.7	2.4	1.8	1.9	2.3	2.4	1.7	2.1		
9½—10½	2.0	2.0	1.8	1.9	1.9	2.1	2.6	2.3	2.8	2.5	1.8	2.0	2.0	1.7	2.8	
10½—11½	1.7	2.1	2.0	1.9	1.9	1.9	1.6	2.4	1.9	1.6	2.9	1.8	1.9	1.5	1.2	
11½—12½	1.8	2.5	1.7	2.3	1.2	2.7	1.6	2.7	1.7	3.1	1.1	3.3	1.9	3.5	1.5	
12½—13½	2.1	2.3	1.9	2.9	2.5	2.2	1.7	3.4	1.8	1.3	1.8	2.5	1.6	1.2	4.3	
13½—14½	2.7	1.8	2.2	1.7	2.4	1.8	2.9	1.2	2.6	2.3	0.5	1.0	3.0	2.5	1.3	
14½—15½	2.4	1.2	2.5	1.7	2.5	1.1	2.1	0.7	3.2	1.3	3.5	1.1	3.0	1.6	3.0	
15½—16½	2.7	0.5	2.1	1.0	2.7	0.6	2.7	0.8	1.4	0.6	2.9	0.0	2.0	0.0	1.2	
16½—17½	1.2	0.3	1.9	0.7	1.5	0.8	2.6	0.0	1.0	0.4	1.4	1.1	1.5	1.2	0.7	
17½—18½			2.1				0.5	0.5	0.6	0.1			0.4	0.1	0.2	
18½—19½															0.2	
19½—20½															0.1	
20½—21½															0.1	

Age.	Moscow M.	Moscow F.	Sweden M.	Sweden F.	Den-mark. M.	Den-mark. F.	Eng-land. Robe'ts M.	Eng-land. Robe'ts F.	Engl'd. Anthro. Com. M.	Engl'd. Anthro. Com. F.	Belg'm. M.	Belg'm. F.	Turin. M.	Turin. F.	Lusan'e M.	Lusan'e F.
0½— 1½											7.8	7.8				
1½— 2½											3.6	3.5				
2½— 3½											2.9	2.9				
3½— 4½									1.7	2.1	2.5	2.4	2.3	2.7		
4½— 5½									2.5	2.3	2.4	2.3	2.0	2.0		
5½— 6½							2.0		3.0	2.3	2.3	2.3	2.5	2.2		
6½— 7½			2.0	1.2	1.2	1.2	1.8		2.0	1.6	2.3	2.2	3.6	2.8		
7½— 8½	2.3	1.9	2.0	2.7	1.9	1.9	2.0		1.1	2.1	2.2	2.2	2.3	2.5	2.0	1.9
8½— 9½	1.9	1.3	2.0	1.6	2.0	2.0	2.2		2.6	2.1	2.3	2.1	2.2	2.1	1.8	1.9
9½—10½	3.2	2.1	0.8	2.0	2.0	2.0	1.3		2.1	2.4	2.1	2.1	1.0	2.5	1.7	2.0
10½—11½	1.9	1.9	1.1	1.9	1.9	1.2	1.0		1.7	2.0	2.1	2.0	1.1	1.6	1.6	2.1
11½—12½	1.8	1.2	1.6	2.4	1.2	1.9	1.5		1.5	3.6	1.9	2.0	1.7	2.1	1.7	2.2
12½—13½	2.0	2.2	1.6	2.0	2.0	3.2	2.9		1.9	1.1	1.8	1.9	2.4	2.3	1.9	2.0
13½—14½	1.9		2.0	1.9	2.4	1.9	1.9		2.4	2.0	1.8	1.8	2.2	2.8		
14½—15½	2.5		2.7	1.6	2.7	1.2	2.9		2.9	1.1	1.8	1.8	2.6	1.2		
15½—16½	1.9		2.4	0.8	3.2	2.0	2.2		2.1	0.8	1.6	1.3	2.4	0.5		
16½—17½	1.1		1.9	0.4	1.1		1.6		1.9	0.8	1.6	1.0	0.8	0.4		
17½—18½			1.2		1.2		1.0		0.8		1.4	0.6	0.3			
18½—19½			0.4				0.5		0.3		1.0	0.3	0.4			
19½—20½			0.4				0.3				0.5	0.2				
20½—21½																

Age.	Freib'g. M.	Freib'g. F.	Breslau M.	Breslau F.	Gohlis. M.	Gohlis. F.	Posen. M.	Posen. F.	Hamb'g M.	Hamb'g F.	Saalfe'd M.	Saalfe'd F.	Radom. M.	Radom. F.	Halle. Schm't-Monn'd. M.	Halle. Schm't-Monn'd. F.
0½— 1½															7.2	7.4
1½— 2½															4.5	3.0
2½— 3½															3.7	2.6
3½— 4½															2.8	3.2
4½— 5½															2.6	2.6
5½— 6½															2.3	2.4
6½— 7½	1.5	1.6	1.8		1.6	1.8	2.1				2.0	2.2			2.9	2.2
7½— 8½	2.0	1.8	2.0		2.0	1.5	2.0				2.2	1.7			1.7	1.7
8½— 9½	1.8	1.9	1.9		1.8	2.5	1.9				2.0	2.2			1.8	1.8
9½—10½	1.5	1.8	1.9		2.0	1.8	1.3		0.9		1.3	2.1	1.5		1.7	1.6
10½—11½	1.8	2.0	1.9		1.3	2.1	1.8		1.7		1.8	1.7	1.6		1.6	1.7
11½—12½	1.9	1.7	1.9		2.3	2.2	2.0		1.9		2.0	2.0	1.4		1.7	1.7
12½—13½	1.9	2.4	2.0		1.0	2.2	1.9		1.2		1.7	2.2	2.4		1.8	2.1
13½—14½			2.3						2.3				2.2		1.7	1.9
14½—15½			3.0						2.1				2.8		2.2	1.8
15½—16½			2.4						3.0				2.0			
16½—17½									2.0				1.7			
17½—18½													0.3			
18½—19½																
19½—20½																
20½—21½																

*See explanation p. 259.

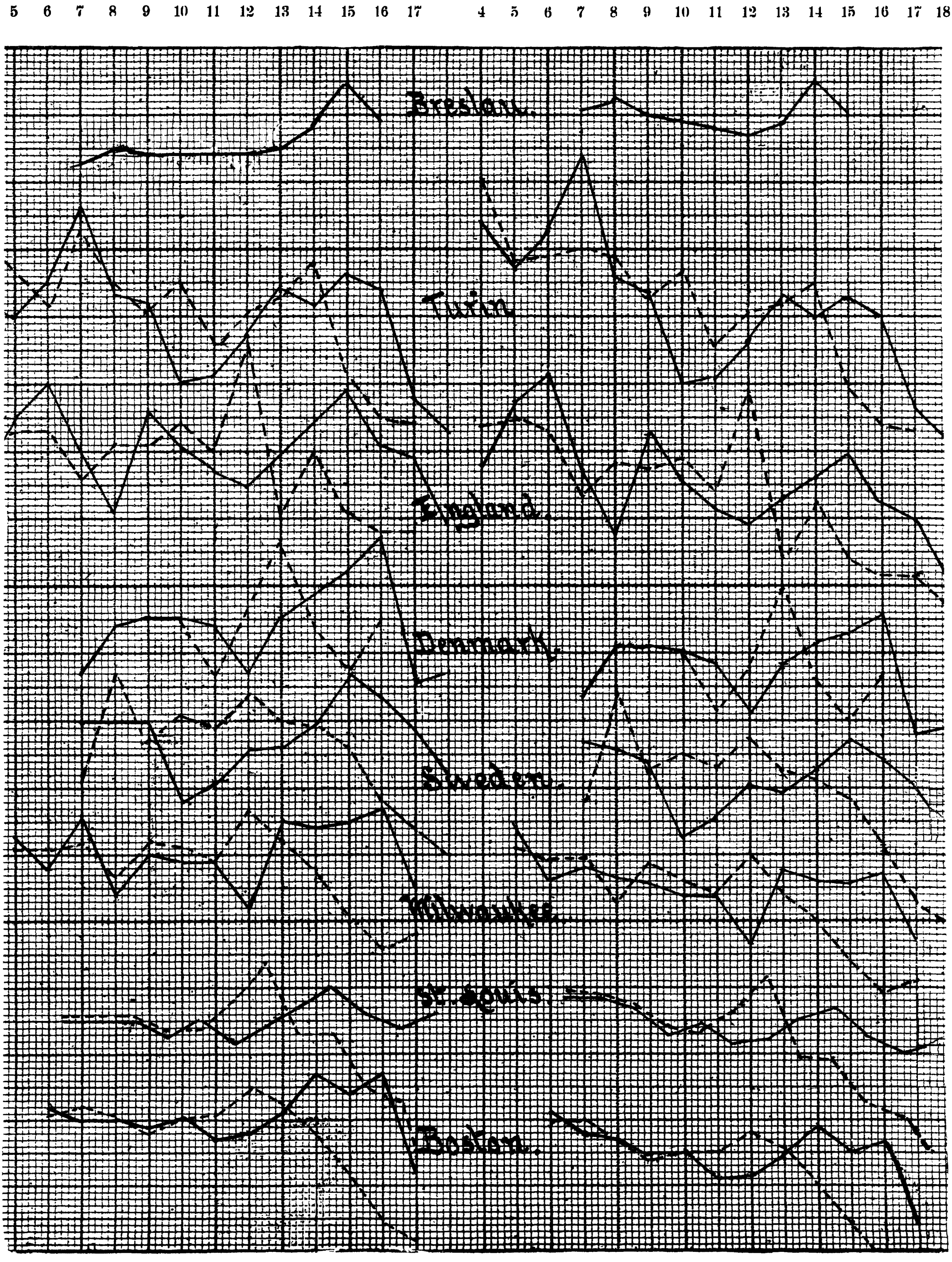
TABLE C.

Showing the Percentage of Increase in Height of each Year's Growth.

AGE.	Boston.		St. Louis.		Mil-wauk'e.		Oak-land.		Wor-cester.		New Haven.		Moscow		Sweden		Den-mark.		Engl'd. Anthro. Com.		Turin.		Lau-sanne.		Freib'g.		Breslau		Posen.		Radom.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0½— 1½																																
1½— 2½																																
2½— 3½																																
3½— 4½																			4.6	5.8	6.8	8.1										
4½— 5½					5.9	5.2													6.5	6.0	5.5	5.6										
5½— 6½	5.2	5.0			4.3	4.9			2.7	3.6									7.3	5.7	6.5	5.8										
6½— 7½	4.6	5.0	4.7	4.9	4.6	4.9	2.0	1.1	3.8	5.7	4.7	4.5			4.4	2.7	2.7	2.7	4.5	3.7	8.8	7.0			3.5	3.8	4.1		5.0			
7½— 8½	4.4	4.5	4.7	4.8	4.3	3.6	5.8	4.2	4.5	3.5	3.8	3.2	5.2	4.3	4.2	5.9	4.2	4.2	2.4	4.7	5.2	5.8	4.3	4.1	4.5	4.1	4.5		4.5			
8½— 9½	4.0	3.8	4.4	4.5	4.1	4.7	3.6	5.1	3.8	3.9	4.7	5.0	4.1	2.8	4.0	3.3	4.2	4.2	5.5	4.5	4.7	4.6	3.7	4.0	3.9	4.1	4.0		4.2			
9½—10½	4.0	4.0	3.6	3.9	3.7	4.2	5.3	4.7	5.5	5.0	3.5	3.9	6.6	4.5	1.6	4.0	4.1	4.1	4.2	4.9	2.0	5.3	3.4	4.0	3.1	3.8	3.9		2.7		3.0	
10½—11½	3.2	4.0	3.9	3.7	3.7	3.7	3.1	4.7	3.6	3.1	5.5	3.4	3.7	3.9	2.1	3.7	3.7	2.3	3.3	3.9	2.2	3.2	3.1	4.1	3.6	4.0	3.7		3.7		3.1	
11½—12½	3.3	4.6	3.3	4.4	2.3	5.0	3.0	5.0	3.1	5.8	2.0	6.0	3.4	2.3	3.0	4.5	2.3	3.6	2.8	6.8	3.3	4.1	3.2	4.1	3.7	3.3	3.6		4.0		2.7	
12½—13½	3.8	4.1	3.4	5.3	4.5	3.9	3.1	6.0	3.2	2.3	3.2	4.3	3.6	4.2	2.9	3.6	3.7	5.9	3.5	1.9	4.6	4.3	3.5	3.6	3.6	4.5	3.8		3.5		4.4	
13½—14½	4.7	3.1	4.0	2.9	4.2	3.1	5.1	2.0	4.5	3.9	0.9	1.7	3.3		3.5	3.3	4.3	3.3	4.2	3.5	4.0	5.0					4.0				3.9	
14½—15½	4.0	1.9	4.3	2.8	4.1	1.8	3.1	1.1	5.3	2.1	5.9	1.8	4.2		4.6	2.7	4.6	2.0	4.9	1.8	4.5	2.0					5.0				4.8	
15½—16½	4.3	0.8	3.5	1.6	4.4	0.9	4.4	1.3	2.2	0.9	4.6	0.0	3.1		3.9	1.3	5.2	3.3	3.4	1.3	4.0	0.8					4.0				3.3	
16½—17½	1.8	0.5	3.0	1.1	2.4	1.2	4.0	0.0	1.6	0.6	2.1	1.8	1.7		3.0	0.6	1.7		3.0	1.3	1.3	0.7									2.7	
17½—18½			3.2	0.1											1.8	0.0	1.8		1.2		0.5										0.6	
18½—19½															0.6				0.4		0.6											
19½—20½															0.6																	
20½—21½																																

CHART I.—RATE OF GHOWTH IN HEIGHT.

Curves on left show the Absolute Annual Increases for places named taken from Table B; continuous lines represent averages for boys, dotted lines averages for girls. The smallest divisions of the ruled lines are millimeters; each millimeter in vertical height represents one-tenth of an inch in growth. Curves on right show the percentage annual increases taken from Table C; sexes indicated as above; each vertical distance of five millimeters represents 1 per cent. in growth.



son that he reckoned age by "the nearest birthday," while all others use the last birthday. Since an average of a year's ages is based upon children from the beginning to those born 364 days later, an average really gives, in all tables except that of Porter, the height of a child in the middle of the year. For example, the average height given of children 7 years really means the height of a child 7½ years, assuming of course that ages are evenly distributed in time. In the case of Dr. Porter, however, who counts as 7 years of age children 6½ to 7½ (*i. e.*, the nearest birthday), the average is at 7 years, or 6 months younger. This explanation also applies to the weights. In almost all investigations the children were measured without shoes. In one or two instances (*e. g.*, Gilbert) shoes were worn. So far as known, these facts are stated at the head of each column.

Table B shows the absolute annual increases obtained from Table A by subtracting the average height of one age from the next.

Table C gives the "percentage" or "relative" annual increase. The rate of increase has generally been determined merely by the absolute annual increase. But such a method neglects to take into account the different heights of the different years, and it is perhaps unfair to say because a large boy increases slightly more than a small boy, that therefore he is actually growing faster. Relative to their respective sizes in the beginning, the small child may make a larger increase in proportion to size. As Porter points out, it would be fairer to find in each case the percentage of his own size which each boy grows (by dividing the year's increase by the size at the beginning of the year). Minot also indorses the system of percentages. He says: "In the writings of Quetelet, Cowell, Roberts, Gould, Pagliani, Street, Boulton, Liharzik, Bowditch and others, the rate of growth is discussed, but I am compelled to consider that they have all misapplied the term. They compare the index of the rate, the actual, absolute increments of equal successive periods; but since during each period the size of the body increases, then if the rate of growth were constant, the proportionate increment would remain the same, but the absolute increments would become steadily larger. Reciprocally, it is evident from this that if the absolute increments are constant, the rate of growth diminishes, a point which, so far as I am aware, has been entirely overlooked hitherto."

Chart I represents graphically the increases in height.

In connection with the height, Chart III should be consulted, showing the growth in height of the average American child, and also his absolute and percentage annual increases.

WEIGHT.

There has been some discussion upon the question whether height or weight is the better index of fundamental growth conditions. Donaldson (†[29]) decides in favor of weight, for the reason that while the body increases in stature from birth to thirty years only 3.37 fold, in volume the increase is 20.66 fold. He thinks, therefore, that weight is a better index of the complex changes which growth implies. His view is not held by the majority of anthropometrists. The general view is rather in favor of using height as the index. Increase in

---

([29]) Pp. 49-50.

weight varies irregularly throughout life, depending intimately upon external conditions. The absorption of water and the accumulations of fats which constitute elements not properly considered increments of permanent significance, render it impossible to determine the essential growth, by weight.

Vierordt ([94]) concludes that the average weight of the male at birth may be put at 3,333 grammes (7.3 lbs.), and of females at 3,200 grammes (7.1 lbs.)

Vierordt gives the following averages:

	Boys.	Girls.
Spiegelberg, Breslau,	3,201 gr.	3,056 gr.
Gregory, Munich,	3,355	3,386
Schutz, Leipzig,	3,399	3,233
Ingerslev,	3,381	3,280
Kézmarsky, Perth,	3,383	3,284
Quetelet, Brussels,	3,100	3,000
Wagner, Königsberg,	3,479	3,339

The Report of the Anthropometric Committee (†[37]) from data of 451 boys and 466 girls in London and Edinburgh hospitals, places the average of boys at 7.1 pounds and of girls at 6.9 pounds. Roberts (†[82]) from data of 100 English new-born children, finds that the boys range in weight from 3 to 12 pounds, but that 87 per cent. are between 6 and 9 pounds; the females range in weight from 4 to 11 pounds, and 85 per cent. are between 6 and 9 pounds. Elsässer, in Stuttgart, from 1,000 observations, finds that 976 children vary from 5 to 9 pounds (German).

Siebold, from data of 3,000 new-born infants, finds the extreme variations from 4 to 11 pounds (German); only 169 fall outside of the limits of 5½ to 8½ pounds. Fasbender ([93]) finds that first-born children average 189 grammes lighter than later born, but the relations seem to change later, for Boas ([14]) concludes that after the sixth year first-born children are heavier as well as taller than later born.

The development by weight seems, on the whole, to follow the law of development in height. The weight at birth is almost trebled during the first year. The rate of growth decreases very rapidly at first, more slowly later, and up to the period of maturity shows fluctuations indicative of periods of rapidity followed by periods of comparative rest.

The period of infantile growth in weight and that of the period up to six years will be found reviewed by Vierordt ([93, 94, 95]). The more important recent contributions are those of Camerer ([22, 23]) and of Daffner ([27]).

Up to the period of prepubertal growth, there is no material difference in the absolute average weight of the two sexes. At 6 years, a comparison of the average weights, as given in the table, will show that the sexes vary less than two pounds, with the advantage in favor of the boys. From six to ten

---

([37]) P. 34. ([82]) P. 79.

Table E.

Showing the Weight at Successive Ages in Different Countries and Cities (pounds).

Age.	Boston. (Bowd'h.)[18] 13,691 Boys. 10,904 Girls.		St. Louis. (Porter.)[78] 16,295 Boys. 18,059 Girls. Age nearest Birth-day.		Milwaukee. (Peck'm.)[76] 4,773 Boys. 4,891 Girls.		Oakland.[75] Number not Stated.		Worcester. (West.)[102] 3,250 Children.		New Haven (Gilbert.)[44] About 50 of each sex for each age.		Iowa. (Gilbert.)[45] About 50 of each sex for each age.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0														
1½														
2½														
3½														
4½					38.8	36.3								
5½	41.1	39.7			41.1	40.0			42.63	39.36				
6½	45.2	43.3	43.7	41.7	44.8	43.1	47.6	45.9	46.04	43.70	46.8	44.3	45.9	41.6
7½	49.1	47.5	47.8	45.9	49.1	47.0	50.2	48.1	49.37	47.96	51.2	50.4	51.4	47.4
8½	53.9	52.0	52.5	50.5	53.8	50.9	54.2	52.2	53.64	51.50	52.5	53.0	55.0	51.0
9½	59.2	57.1	57.5	55.3	59.5	56.4	59.6	58.6	59.81	57.37	60.0	58.8	61.6	58.1
10½	65.3	62.4	62.4	60.6	65.4	62.4	66.7	63.2	66.51	63.52	68.4	62.7	63.7	62.1
11½	70.2	68.8	63.3	66.6	70.9	68.8	72.0	69.7	71.00	69.94	70.8	70.0	72.4	69.2
12½	76.9	78.3	73.9	74.3	76.1	77.8	77.9	78.9	78.75	79.74	82.3	84.5	78.2	79.7
13½	84.8	88.7	80.7	84.9	84.9	88.0	89.4	90.7	86.13	87.66	88.0	92.0	90.9	94.1
14½	94.9	98.4	89.1	93.3	95.8	97.6	97.0	98.2	98.18	99.10	91.7	98.0	102.0	99.9
15½	107.1	106.1	101.9	103.0	109.0	105.9	108.1	108.9	112.2	105.0	110.0	104.0	117.0	111.3
16½	121.0	112.0	113.8	110.9	122.1	110.6	121.6	109.8	123.6	109.0	127.0	113.0	130.0	111.6
17½	127.5	115.5	122.8	116.0	130.4	113.3	131.7	117.7	132.9	115.0	130.0	113.7	140.1	121.0
18½	132.6	115.2		115.5	137.8	112.5	137.7	118.3	133.2	120.0			142.6	125.5
19½				115.1					142.6	118.3			145.5	126.4
20½				118.8						119.8				
21½														

Age.	Pennsylv'a. (Hall.)[48] 2,434 Males (nude).		Sweden Com'ission. (Key.)[58] 15,000 Boys. 3,000 Girls.		Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls.		Moscow. (Erism'n)[31] 2,453 Boys. 1,495 Girls.		Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls.		Gohlis. (Geissler)[43] 1,386 Boys. 1,420 Girls.		Belgium. (Quete't.)[80] Selected Ten of each Age and Sex.		England. (Robe'ts.)[82] Over 10,000 Males.		England. (Anthrop. Com.)[37] Over 30,000 Persons.		Denmark. (Vahl.)[92]		S (Sc 4,6 4,8
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M
0													6.8	6.6	7.6		7.1	6.9			
1½													21.8	19.0							
2½													24.3	24.3							
3½									27.3	24.7			27.6	27.3			34.0	31.6		32.3	
4½									29.8	28.9			30.9	30.6	41.2		37.3	36.1		35.8	
5½									33.5	33.1			35.1	33.7	50.0		40.0	39.2		39.5	
6½			45.2		46.3	44.1	44.1	42.8	36.8	36.2	47.2	45.2	39.2	36.8	54.2		44.4	41.7		41.6	4
7½			50.3	47.6	49.6	47.4	48.5	47.0	42.8	39.0	50.5	49.4	43.4	39.2	56.9		50.0	47.5		48.4	4
8½			57.8	55.1	52.9	51.8	53.1	48.5	45.6	41.9	54.5	54.0	47.6	41.9	59.0		54.9	52.1		53.6	5
9½	58.4		64.6	59.3	57.3	56.2	61.1	56.4	49.4	48.3	58.9	57.8	51.8	46.3	62.6		60.4	55.5		59.0	5
10½	66.1		66.8	64.8	62.8	61.7	67.2	60.4	54.7	54.5	63.5	62.8	55.6	50.9	66.3		68.0	62.0		64.9	5
11½	71.7		71.0	70.3	68.3	67.2	73.4	66.8	58.6	59.3	70.5	69.7	59.5	56.2	69.5		72.0	68.1		74.0	6
12½	80.5		76.1	79.1	73.9	75.0	82.9	80.5	64.6	65.0	76.3	77.8	63.9	63.9	73.7		76.7	76.4		80.6	7
13½	89.7		82.9	87.3	80.5	83.8	91.5	89.3	72.8	76.1	79.4	85.1	73.0	71.7	78.3		82.6	87.2		89.8	7
14½	99.6		93.3	98.8	89.3	92.6	102.7	94.4	80.7	84.9			81.8	80.0	84.6		92.0	96.7		101.3	7
15½	108.7		103.2	107.8	102.6	102.6	116.8	99.9	92.2	96.6			90.8	88.2	96.8		102.7	106.3		108.6	
16½	125.7		115.3	113.8	116.8	112.4	126.6	101.0	104.1	100.8			100.1	95.9	108.7		119.0	113.1		100.9	
17½	133.8		127.0	120.4	126.8		132.5		116.2	104.7			109.6	103.2	116.4		130.9	115.5			
18½	138.7		135.1	124.1	134.5				118.6	107.1			118.8	109.8	123.3		137.4	121.1			
19½	140.7		139.6	126.6					121.3				127.0	114.9	128.4		139.6	123.8			
20½	142.6		143.7	127.2									131.2	117.3	130.6		143.3	123.4			
21½	145.1																145.2	121.8			

TABLE E.

Showing the Weight at Successive Ages in Different Countries and Cities (pounds).

[Milw]aukee. [Pec]k'm.)[76] Boys. Girls.	Oakland.[75] Number not Stated.		Worcester. (West.)[102] 3,250 Children.		New Haven (Gilbert)[44] About 50 of each sex for each age.		Iowa. (Gilbert)[45] About 50 of each sex for each age.		Pennsylv'a. (Hall.)[48] 2,434 Males (nude).		Sweden Com'ission. (Key.)[58] 15.000 Boys. 3,000 Girls.		Denmark Com'ission. (Hertel.)[51] 17.134 Boys. 11,250 Girls.		Moscow. (Erism'n)[31] 2,453 Boys. 1,495 Girls.		Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls.		Gohlis. (Geissler)[43] 1,386 Boys. 1,420 Girls.		Belgium. (Quete't.)[80] Selected Ten of each Age and Sex.		England. (Robe'ts)[82] Over 10,000 Males.		England. (Anthrop. Com.)[37] Over 30,000 Persons.		Denmark. (Vahl.)[92]		Saalfeld. (Schmidt)[85] 4,699 Boys. 4,807 Girls.		Radom. (Suligowski.)[88] 1,133 Boys.		Japan. (Miwa.)[71] 1,250 Boys. 2,800 Girls.	
F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
																					6.8	6.6	7.6		7.1	6.9								
																					21.8	19.0												
																					24.3	24.3												
																	27.3	24.7			27.6	27.3			34.0	31.6		32.3					31.0	29.6
36.3																	29.8	28.9			30.9	30.6	41.2		37.3	36.1		35.8					33.0	32.6
40.0			42.63	39.36													33.5	33.1			35.1	33.7	50.0		40.0	39.2		39.5					36.1	34.3
43.1	47.6	45.9	46.04	43.70	46.8	44.3	45.9	41.6			45.2		46.3	44.1	44.1	42.8	36.8	36.2	47.2	45.2	39.2	36.8	54.2		44.4	41.7		41.6	41.9	40.1			37.9	37.0
47.0	50.2	48.1	49.37	47.96	51.2	50.4	51.4	47.4			50.3	47.6	49.6	47.4	48.5	47.0	42.8	39.0	50.5	49.4	43.4	39.2	56.9		50.0	47.5		48.4	46.7	44.8			41.9	39.4
50.9	54.2	52.2	53.64	51.50	52.5	53.0	55.0	51.0			57.8	55.1	52.9	51.8	53.1	48.5	45.6	41.9	54.5	54.0	47.6	41.9	59.0		54.9	52.1		53.6	51.1	48.5			44.7	43.2
56.4	59.6	58.6	59.81	57.37	60.0	58.8	61.6	58.1	58.4		64.6	59.3	57.3	56.2	61.1	56.4	49.4	48.3	58.9	57.8	51.8	46.3	62.6		60.4	55.5		59.0	55.8	53.8	55.3		49.3	48.1
62.4	66.7	63.2	66.51	63.52	68.4	62.7	63.7	62.1	66.1		66.8	64.8	62.8	61.7	67.2	60.4	54.7	54.5	63.5	62.8	55.6	50.9	66.3		68.0	62.0		64.9	58.6	58.6	61.8		52.6	52.4
68.8	72.0	69.7	71.00	69.94	70.8	70.0	72.4	69.2	71.7		71.0	70.3	68.3	67.2	73.4	66.8	58.6	59.3	70.5	69.7	59.5	56.2	69.5		72.0	68.1		74.0	65.7	65.0	68.0		57.2	57.6
77.8	77.9	78.9	78.75	79.74	82.3	84.5	78.2	79.7	80.5		76.1	79.1	73.9	75.0	82.9	80.5	64.6	65.0	76.3	77.8	63.9	63.9	73.7		76.7	76.4		80.6	71.0	72.1	73.4		62.1	66.2
88.0	89.4	90.7	86.13	87.66	88.0	92.0	90.9	94.1	89.7		82.9	87.3	80.5	83.8	91.5	89.3	72.8	76.1	79.4	85.1	73.0	71.7	78.3		82.6	87.2		89.8	77.2	80.7	82.1		72.1	73.3
97.6	97.0	98.2	98.18	99.10	91.7	98.0	102.0	99.9	99.6		93.3	98.8	89.3	92.6	102.7	94.4	80.7	84.9			81.8	80.0	84.6		92.0	96.7		101.3	79.8		91.9		83.4	85.6
105.9	108.1	108.9	112.2	105.0	110.0	104.0	117.0	111.3	108.7		103.2	107.8	102.6	102.6	116.8	99.9	92.2	96.6			90.8	88.2	96.8		102.7	106.3		108.6			103.6		92.2	90.9
110.6	121.6	109.8	123.6	109.0	127.0	113.0	130.0	111.6	125.7		115.3	113.8	116.8	112.4	126.6	101.0	104.1	100.8			100.1	95.9	108.7		119.0	113.1		100.9			112.5		100.1	93.3
113.3	131.7	117.7	132.9	115.0	130.0	113.7	140.1	121.0	133.8		127.0	120.4	126.8		132.5		116.2	104.7			109.6	103.2	116.4		130.9	115.5					123.4		109.5	99.6
112.5	137.7	118.3	133.2	120.0			142.6	125.5	138.7		135.1	124.1	134.5				118.6	107.1			118.8	109.8	123.3		137.4	121.1					126.8		108.3	100.8
			142.6	118.3			145.5	126.4	140.7		139.6	126.6					121.3				127.0	114.9	128.4		139.6	123.8					127.2		112.1	99.5
				119.8					142.6		143.7	127.2									131.2	117.3	130.6		143.3	123.4					130.7		111.9	101.3
									145.1																145.2	121.8					136.9		112.5	

TABLE F.

Showing the Absolute Annual Increases in Weight (pounds): Obtained by Subtracting Successive Weights in Table E.

AGE.	Boston.		St. Louis.		Milwaukee.		Oakland.		Worcester.		New Haven		Iowa.		Pennsyl'a	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0½— 1½																
1½— 2½																
2½— 3½																
3½— 4½																
4½— 5½					2.3	3.7										
5½— 6½	4.1	3.7			3.7	3.1			3.4	4.3						
6½— 7½	3.9	4.2	4.1	4.2	4.3	3.9			3.3	4.3	4.4	6.1	5.6	5.8		
7½— 8½	4.9	4.6	4.7	4.6	4.7	3.9	4.0	4.1	4.3	3.5	1.3	2.6	3.6	3.6		
8½— 9½	5.3	5.0	5.0	4.8	5.7	5.5	5.4	6.4	6.2	5.9	7.5	5.8	6.6	7.1		
9½—10½	6.1	5.3	4.9	5.3	5.9	6.0	7.1	4.6	6.7	6.2	8.4	3.9	2.1	4.0	7.7	
10½—11½	4.9	6.5	5.9	6.0	5.5	6.4	5.3	6.5	4.5	6.4	2.4	7.3	8.7	7.1	5.6	
11½—12½	6.7	9.5	5.1	7.7	5.2	9.0	5.9	9.2	7.7	9.8	11.5	14.5	5.8	10.5	8.8	
12½—13½	7.9	10.3	6.8	10.6	8.8	10.2	11.5	11.8	7.4	7.9	5.7	7.5	12.7	14.4	9.2	
13½—14½	10.1	9.8	8.4	8.4	10.9	9.6	7.6	7.5	12.0	11.4	3.7	6.0	11.1	5.9	9.9	
14½—15½	12.2	7.6	12.8	9.7	13.2	8.3	11.1	10.7	13.0	5.9	18.3	6.0	15.0	11.3	9.1	
15½—16½	13.9	6.0	11.9	7.9	13.1	4.7	13.5	0.9	11.6	4.0	17.0	9.0	13.0	0.3	17.0	
16½—17½	6.5	3.5	9.0	5.1	8.3	2.7	10.1	7.9	9.3	6.0	3.0	0.7	10.1	9.4	8.1	
17½—18½					7.4		6.0	0.6	0.3	5.0			2.4	4.5	4.9	
18½—19½													2.9	0.9	2.0	
19½—20½															1.9	
20½—21½															2.5	
21½—22½																

AGE.	Sweden.		Denmark.		Moscow.		Turin.		Gohlis.		Belgium.		England. Roberts.		England. Anthrop. Com.		Ham
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.
0½— 1½											15.0	12.4					
1½— 2½											2.5	5.3					
2½— 3½											3.3	3.0					
3½— 4½							2.5	4.2			3.3	3.3			3.3	4.5	
4½— 5½							3.7	4.2			4.2	3.1			2.7	3.1	
5½— 6½							3.3	3.1			4.1	3.1	4.2		4.4	2.5	
6½— 7½	5.1		3.3	3.3	4.4	4.2	6.0	2.8	3.3	4.2	4.2	2.4	2.7		5.6	5.8	
7½— 8½	7.5	7.5	3.3	4.4	4.6	1.5	2.8	2.9	4.0	4.6	4.2	2.7	2.1		4.9	4.6	
8½— 9½	6.8	4.2	4.4	4.4	8.0	7.9	3.8	6.4	4.4	3.8	4.2	4.4	3.6		5.5	3.4	
9½—10½	2.2	5.5	5.5	5 5	6.1	4.0	5.3	6.2	4.6	5.0	3.8	4.6	3.7		7.6	6.5	3.1
10½—11½	4.2	5.5	5.5	5.5	6.2	6.4	3.9	4.8	7.0	6.9	3.9	5.3	3.2		4.0	6.1	5.3
11½—12½	5.1	8.8	5.6	7.8	9.5	13.7	6 0	5.7	5.8	8.1	4.4	7.7	4.2		4.7	8.3	7.1
12½—13½	6.8	8.2	6.6	8.8	8.6	8.8	8.2	11.1	3.1	7.3	9.1	7.8	4.6		5.9	10.8	4.2
13½—14½	10.4	11.5	8.8	8.8	11.2	5.1	7.9	8.8			8.8	8.3	6.3		9.4	9.5	11.5
14½—15½	9.9	9.0	13.3	10.0	14.1	5.5	11.5	11.7			9.0	8.2	12.2		10.7	9.6	10.8
15½—16½	12.1	6.0	14.2		9.8	1.1	11.9	4.2			9.3	7.7	11.9		16.3	6.8	13.2
16½—17½	11.7	6.6	10.0		5.9		12.1	3.9			9.5	7.3	7.7		11.9	2.4	10.8
17½—18½	8.1	3.7	7.7				2.4	2.4			9.3	6.6	6.9		6.5	5.6	7.7
18½—19½	4.5	2.4					2.7				8.2	5.1	5.1		2.2	2.7	3.3
19½—20½	4.1	0.6									4.2	2.4	2.2		3.7		3.7
20½—21½															1.9		
21½—22½															1.7		

TABLE F.

Showing the Absolute Annual Increases in Weight (pounds): Obtained by Subtracting Successive Weights in Table E.

New Haven		Iowa.		Pennsyl'a		Sweden.		Denmark.		Moscow.		Turin.		Gohlis.		Belgium.		England. Roberts.		England. Anthrop. Com.		Hamburg.		Saalfeld.		Radom.		Denmark. Vahl.		Halle.		Japan.	
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
																15.0	12.4													11.5	11.7		
																2.5	5.3													5.5	6.2		
																3.3	3.0													6.0	3.7		
												2.5	4.2			3.3	3.3			3.3	4.5								3.5	4.0	4.0	2.0	3.0
												3.7	4.2			4.2	3.1			2.7	3.1								3.7	3.7	3.1	3.1	1.7
												3.3	3.1			4.1	3.1	4.2		4.4	2.5								2.1	4.2	4.2	1.8	2.7
4.4	6.1	5.6	5.8			5.1		3.3	3.3	4.4	4.2	6.0	2.8	3.3	4.2	4.2	2.4	2.7		5.6	5.8			4.8	4.7				6.8	4.8	4.2	4.0	2.4
1.3	2.6	3.6	3.6			7.5	7.5	3.3	4.4	4.6	1.5	2.8	2.9	4.0	4.6	4.2	2.7	2.1		4.9	4.6			4.4	3.7				5.2	3.3	0.1	2.8	3.8
7.5	5.8	6.6	7.1			6.8	4.2	4.4	4.4	8.0	7.9	3.8	6.4	4.4	3.8	4.2	4.4	3.6		5.5	3.4			4.7	5.3				5.4	6.4	3.5	4.6	4.9
8.4	3.9	2.1	4.0	7.7		2.2	5.5	5.5	5 5	6.1	4.0	5.3	6.2	4.6	5.0	3.8	4.6	3.7		7.6	6.5	3.1		2.8	4.8	6.5			5.9	4.4	4.8	3.3	4.3
2.4	7.3	8.7	7.1	5.6		4.2	5.5	5.5	5.5	6.2	6.4	3.9	4.8	7.0	6.9	3.9	5.3	3.2		4.0	6.1	5.3		7.1	6.4	6.2			9.1	5.1	4.4	4.6	5.2
11.5	14.5	5.8	10.5	8.8		5.1	8.8	5.6	7.8	9.5	13.7	6 0	5.7	5.8	8.1	4.4	7.7	4.2		4.7	8.3	7.1		5.3	7.1	5.4			6.6	6.0	5.5	4.9	8.6
5.7	7.5	12.7	14.4	9.2		6.8	8.2	6.6	8.8	8.6	8.8	8.2	11.1	3.1	7.3	9.1	7.8	4.6		5.9	10.8	4.2		6.2	8.6	8.7			9.2	6.2	6.8	10.0	7.1
3.7	6.0	11.1	5.9	9.9		10.4	11.5	8.8	8.8	11.2	5.1	7.9	8.8			8.8	8.3	6.3		9.4	9.5	11.5				9.8			11.5	10.1	8.6	11.3	12.3
18.3	6.0	15.0	11.3	9.1		9.9	9.0	13.3	10.0	14.1	5.5	11.5	11.7			9.0	8.2	12.2		10.7	9.6	10.8				11.7			7.3			8.8	5.3
17.0	9.0	13.0	0.3	17.0		12.1	6.0	14.2		9.8	1.1	11.9	4.2			9.3	7.7	11.9		16.3	6.8	13.2				8.9						7.9	2.4
3.0	0.7	10.1	9.4	8.1		11.7	6.6	10.0		5.9		12.1	3.9			9.5	7.3	7.7		11.9	2.4	10.8				10.9						9.4	6.3
		2.4	4.5	4.9		8.1	3.7	7.7				2.4	2.4			9.3	6.6	6.9		6.5	5.6	7.7				3.4							1.2
		2.9	0.9	2.0		4.5	2.4					2.7				8.2	5.1	5.1		2.2	2.7	3.3				0.4							
				1.9		4.1	0.6									4.2	2.4	2.2		3.7		3.7				3.5							
				2.5																1.9						6.2							
																				1.7													

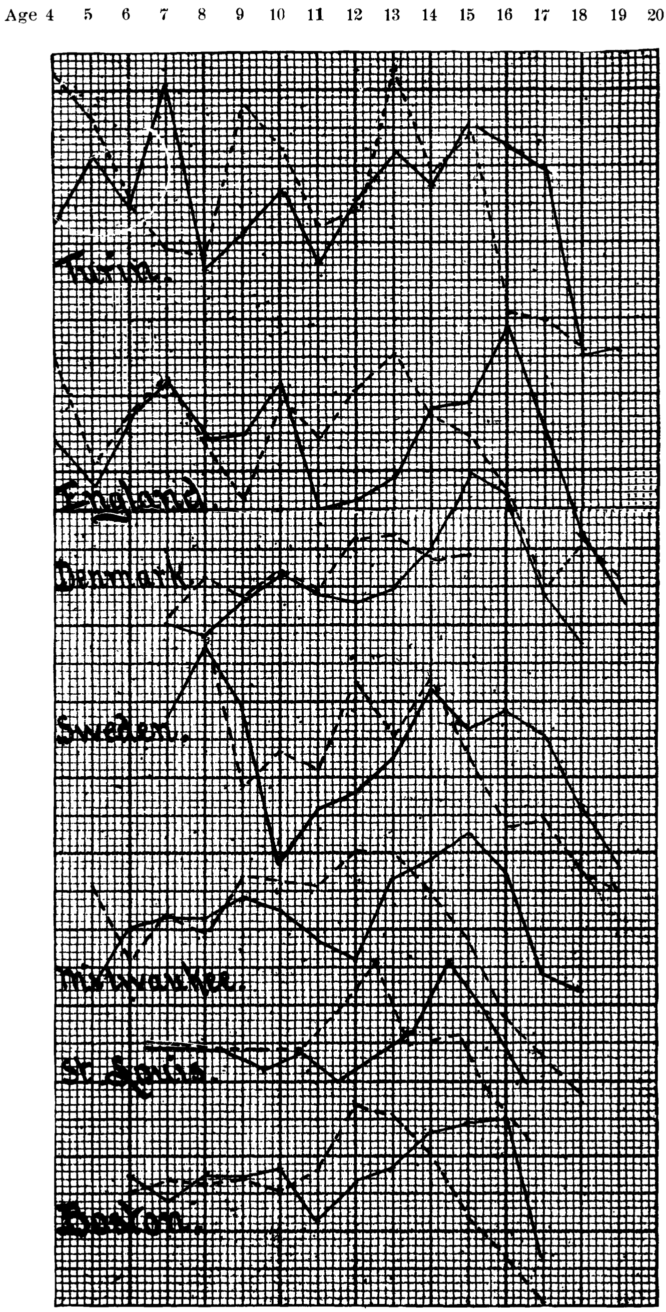
TABLE G.

Showing the Percentage of Increase of Weight.

AGE.	Boston.		St. Louis.		Milwaukee.		Oakland.		Worcester.		New Haven		Moscow.		Sweden.		Denmark.		England. Anthrop. Com.		Turin.		Radom.		Japan.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
3½— 4½																			9.7	14.2	9.2	17.0			6.5	10.1
4½— 5½					5.8	10.2													7.2	8.6	12.4	14.5			9.4	5.2
5½— 6½	9.9	9.1			9.0	7.8			8.0	10.9									11.0	6.4	9.9	9.4			5.0	7.9
6½— 7½	8.6	9.7	9.7	10.0	9.6	9.8			7.2	9.8	9.4	13.8	10.0	9.8	11.3		7.1	7.5	12.6	13.9	16.3	7.7			10.6	6.5
7½— 8½	9.9	9.6	9.7	9.9	9.6	8.9	8.0	8.5	8.7	7.3	2.5	5.2	9.5	3.3	14.9	15.7	6.7	9.3	9.8	9.7	6.5	7.4			6.7	9.6
8½— 9½	9.9	9.7	9.6	9.6	10.6	10.8	10.0	12.3	11.6	11.5	14.3	10.9	15.1	16.4	11.8	7.6	8.3	8.5	10.0	6.5	8.3	15.3			10.3	11.3
9½—10½	10.3	9.2	8.7	9.6	9.9	10.6	11.9	7.8	11.2	10.8	14.0	6.6	10.0	17.0	3.4	9.3	9.6	9.8	12.6	11.7	10.7	12.8	11.8		6.7	8.9
10½—11½	7.5	10.4	9.5	9.7	8.4	10.2	7.9	10.3	6.8	10.1	3.5	11.6	9.2	10.6	6.3	8.5	8.8	8.9	5.9	9.8	7.1	8.8	10.0		8.7	9.9
11½—12½	9.6	13.7	8.1	11.6	7.3	13.1	8.2	13.2	10.8	14.0	16.2	20.7	12.9	20.5	7.2	12.5	8.2	11.6	6.5	12.2	10.2	9.6	7.9		8.6	14.9
12½—13½	10.3	13.2	9.3	14.3	11.6	13.0	14.8	15.0	9.4	9.9	6.9	8.9	10.4	11.0	8.9	10.3	8.9	11.7	7.7	14.1	12.7	17.1	11.9		16.1	10.7
13½—14½	12.2	11.0	10.5	9.9	12.8	10.9	8.5	8.3	13.9	13.0	4.2	6.5	12 2	5.7	12.5	13.1	10.9	10.5	11.4	10.9	10.9	11.6	11.9		15.7	16.8
14½—15½	12.8	7.8	14.3	10.4	13.9	8.5	11.4	10.9	13.2	5.9	20.0	6.1	13.7	5.8	10.6	9.2	14.9	10.8	11.6	9.9	14.2	13.8	12.8		10.6	6.2
15½—16½	13.0	5.6	11.6	7.6	11.9	4.4	12.5	10.8	10.4	3.8	15.5	8.7	8.4	1.1	11.7	5.5	13.8		15.7	6.4	12.9	4.3	8.6		8.6	2.6
16½—17½	5.4	3.1	7.9	4.7	6.6	2.4	8.3	7.2	7.5	5.5	2.4	0.6	4.7	3.3	10.1	5.8	8.6		10.0	2.1	11.6	3.9	9.7		9.4	6.8
17½—18½					5.7	0.6	4.6	0.5	0.2	4.3				3.0	6.4	3.1	6.1		5.0	4.8	2.1	2.3	2.8			1.2
18½—19½															3.3	2.0			1.6	2.2	2.3		0.3			
19½—20½															2.9	0.5			2.6				2.8			
20½—21½																			1.3				4.7			

CHART II.—RATE OF GROWTH IN WEIGHT.

Curves show the Percentage Annual Increases taken from Table G; continuous lines represent averages for boys, dotted lines for girls; each vertical distance of five millimeters represents 2 per cent. in growth.



years the increase weight in pounds is as follows for American investigations:

	Boston. (Bowditch)	St. Louis. (Porter.)	Milwaukee. (Peckham.)	Oakland.	Worcester. (West.)	New Haven. (Gilbert.)
Boys,	20.1	18.7	20.6	19.1	19.0	21.6
Girls,	19.1	18.9	19.4	17.3	19.5	18.4

There seem to be one or two fluctuations of weights, periods of activity and of rest, apparently between six years and the prepubertal acceleration. This is more marked and more irregular in girls than in boys. As a rule in the case of boys there is to be observed a general rising tendency culminating usually in the 8th, 9th or 10th year, followed by a sudden decrease to its lowest point just before the prepubertal increase. In the case of girls, the ebb tide of growth preceding the prepubertal acceleration is easily distinguishable in all the curves, but the previous rhythms are more irregular. The acceleration period in boys begins from the 11th to 13th year, and ends usually with the 16th, the year of maximum increase being the 14th, 15th or 16th. In the case of girls, the beginning is a year or two earlier than in boys, and is ended usually in the 14th or 15th. It is shorter in duration than the same period in boys.

As in growth in height, owing to the fact that the girls' acceleration begins and ends earlier than that of boys, girls are taller than boys for a period of two or three years. It is interesting to note that this law holds for the Japanese ([71]), a race distinct from the Europeans. The acceleration in girls begins in the 11th year, and they surpass boys in weight until the 15th. This phenomenon and the period of appearance seem practically identical with the form among American children.

Table E corresponds to Table A in heights. The same explanations there made apply here. The usual clothing worn is that of light indoor dress, but of course this varies in different countries and at different seasons of the year. Table F gives the absolute annual increases and Table G the percentage or relative annual increases computed on the same principle as Tables B and C already explained.

The "Average" American Boy and Girl.

Dr. Franz Boas has suggested the feasibility and mathematical propriety of constructing the curve of growth for the

American child by massing the returns from the various localities. Of course the data of a large number of localities are not yet at hand. But the large studies which have been made in Boston, St. Louis, Milwaukee and others have justified a beginning.

TABLE H.

Showing the Average American Height Mathematically Calculated by Dr. Franz Boas from the Data of 45,151 Boys and 43,298 Girls in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto, and Oakland (Cal.); also the Absolute and the Percentage Annual Increases of same.

Approximate Average Age.	Number of Observations.	Boys.			Number of Observations.	Girls.		
		Average for each Year. Inches.	Absolute Annual Increase. Inches.	Perc'tage Annual Increase. Per cent.		Average for each Year. Inches.	Absolute Annual Increase. Inches.	Perc'tage Annual Increase. Per cent.
5½	1,535	41.7			1,260	41.3		
			2.2	5.3			2.0	4.8
6½	3,975	43.9			3,618	43.3		
			2.1	4.8			2.4	5.5
7½	5,379	46.0			4,913	45.7		
			2.8	6.1			2.0	4.4
8½	5,633	48.8			5,289	47.7		
			1.2	2.5			2.0	4.2
9½	5,531	50.0			5,132	49.7		
			1.9	3.8			2.0	4.0
10½	5,151	51.9			4,827	51.7		
			1.7	3.3			2.1	4.1
11½	4,759	53.6			4,507	53.8		
			1.8	3.4			2.3	4.3
12½	4,205	55.4			4,187	56.1		
			2.1	3.8			2.4	4.3
13½	3,573	57.5			3,411	58.5		
			2.5	4.3			1.9	3.2
14½	2,518	60.0			2,537	60.4		
			2.9	4.8			1.2	2.0
15½	1,481	62.9			1,656	61.6		
			2.0	3.2			0.6	1.0
16½	753	64.9			1,171	62.2		
			1.6	2.5			0.5	0.8
17½	429	66.5			790	62.7		
			0.9	1.4				
18½	229	67.4						

Tables H and I and Chart III show the growths in height and weight and the annual absolute and proportional increases for what might be termed the "average" American boy and girl. The average in Table I (weight) has been calculated by the mathematician, M. de Perott, upon the follow-

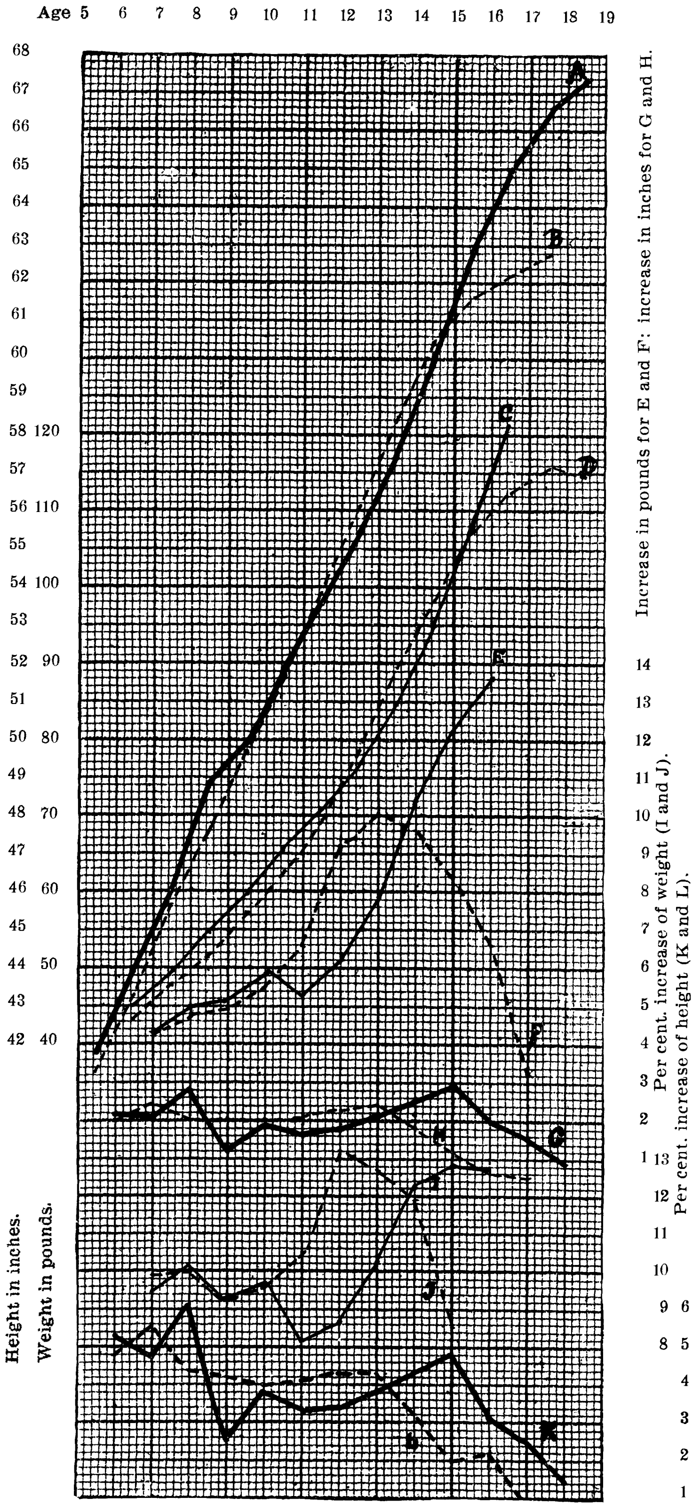


CHART III.

Showing growth curves of average American boy and girl; continuous lines represent boys, and dotted lines girls in all cases. Curves A and B are constructed from the average yearly height in Table H; C and D from average yearly weight of Table I; E and F from absolute annual increases in weight of Table I; G and H from absolute annual increases in height of Table H; I and J from annual percentage increases in weight of Table I; and K L from annual percentage increases in height of Table H.

The column of figures on extreme left represents inches and applies to curves A and B; the second column on left represents pounds and applies to curves C and D; the inner column on the right represents either pounds or inches of absolute increase, according as they are applied to curves E and F, and G and H respectively; the second column on right expresses the percentage increases of weight applying to curves I and J; the column on extreme right expresses percentage increases of height applying to curves K and L.

TABLE I.

Showing the Average American Weight Mathematically Calculated from the Data of about 68,000 Children in the Cities of Boston, St. Louis and Milwaukee; also Absolute and Percentage Annual Increases of same.

AGE.	BOYS.			GIRLS.		
	Average for each Age. Pounds.	Absolute Annual Increase. Pounds.	Annual Increase. Per Cent.	Average for each Age. Pounds.	Absolute Annual Increase. Pounds.	Annual Increase. Per Cent.
6½	45.2	....	....	43.4	....	....
7½	49.5	4.3	9.5	47.7	4.3	9.9
8½	54.5	5.0	10.1	52.5	4.8	10.0
9½	59.6	5.1	9.3	57.4	4.9	9.3
10½	65.4	5.8	9.7	62.9	5.5	9.6
11½	70.7	5.3	8.1	69.5	6.6	10.5
12½	76.9	6.2	8.7	78.7	9.2	13.2
13½	84.8	7.9	10.3	88.7	10.0	12.7
14½	95.2	10.4	12.3	98.3	9.6	11.9
15½	107.4	12.2	12.8	106.7	8.4	8.5
16½	121.0	13.6	12.7	112.3	5.6	5.2
17½	....	....	....	115.4	3.1	2.8
18½	....	....	....	114.9	....	....

ing plan: The averages given by Bowditch from 24,500 children of Boston, by Porter from 34,500 children of St. Louis, and by Peckham from 9,600 children of Milwaukee—making nearly 69,000 children all together — have been thrown together, but not averaged directly. At each age the number of children has been massed from these three sources and each of the three averages allowed to influence the average of the whole in proportion to the number of children each city contributes. Thus, for example, suppose at the age of 10 years St. Louis contributes 5,000 children, Boston 4,000 and Milwaukee 1,000 — altogether there would be 10,000 children of that age—the averages of the three cities would therefore influence the final average in the ratio of 5, 4 and 1, on the same principle we use in partnership.

By the generous courtesy of Dr. Franz Boas the writer is able to present the average heights (in Table H) from a still larger area and larger number of children. Dr. Boas, in an article in the Report of the Commissioner of Education (1896-7) which is shortly to appear, has made an average of the returns from six American cities—Boston, St. Louis, Milwaukee, Toronto, Worcester, and Oakland, Cal. The averages which form the basis are those of Drs. Bowditch, Porter, Peckham and West, and are given in Table A, with exception of the Toronto measurements contained in an, as yet, unpublished study by Dr. Boas. The computation, the writer presumes, has been made upon an identical or similar principle to that used by M. de Perott.

Individual Variations in Height and Weight.

In dealing with averages we must not lose sight of individual variations. The value of averages for practical application to individual children has been a keenly disputed problem ever since Quetelet propounded his theory of types. The problem from a mathematical standpoint will be found elaborately discussed by a variety of different writers.* Individual children of normal rate of growth show a comparatively wide range of deviation at any given period, and also a wide deviation in reaching the crises in the periods of growth.

These variations will be shown by consulting the tables upon Galton's percentile grade system in Porter's "Growth of St. Louis Children," or in the special arrangement of his original data in this form that Bowditch has given in the Twenty-second Annual Report of the Massachusetts Board of Health, 1890.

What may be a still simpler arrangement to show individual variations in height and weight at a given age will be found by Bowditch's original article in his Tables Nos. 4-15. Gilbert in his New Haven and Iowa studies, finds that, on the whole, the variation increases with age, showing a noticeable enlargement during the periods of fastest growth. Previous to 11 years, the variations for boys and girls are about on an equality. In both sexes, Gilbert's curves of mean variation increase quite steadily until the 15th year and then fall off rapidly. This applies for both height and weight. Boys, as a rule, vary more than girls.

From the article by Dr. Franz Boas in the issue of the Report of the Commissioner of Education (1896-7) Tables J and K have been adapted by a reduction of centimeters to inches. The tables are based upon the massing by Dr. Boas of the

*Among recent writers dealing directly with the significance of averages of children's growth, the following references will be found valuable: Boas, *Science*, May 6, 1892, May 20, 1892, Dec. 23, 1892; Porter (27, 78), Bowditch (18, 20), Landsberger, Hall, Peckham, Hansen; Galton, "Natural Inheritance."

Table J.

Showing the Frequency of Stature of Boys of Different Ages mathematically Calculated by Dr. Franz Boas from Data Furnished by the Measurement of 45,151 Boys in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland (Cal.). (Adapted from centimeters to inches.)

Age in Years.		5.589	6.536	7.511	8.504	9.496	10.494	11.492	12.489	13.481	14.467	15.454	16.445	17.453	18.424
Cm.	Inches.														
91	35.83	0.4													
93	36.61	0.6													
95	37.40	1.7	0.1												
97	38.19	3.5	0.4												
99	38.98	6.7	0.7												
101	39.76	10.7	2.2	0.2	0.1	0.1									
103	40.55	15.3	4.9	0.8	0.1	0.1									
105	41.34	16.9	9.0	2.0	0.4	0.1									
107	42.13	13.7	12.2	3.3	0.5	0.1									
109	42.91	13.3	15.5	6.2	1.3	0.1	0.1	0.1							
111	43.70	9.1	15.8	11.1	2.5	0.3	0.1	0.1							
113	44.49	4.3	13.5	13.0	4.6	0.8	0.1	0.1							
115	45.28	2.3	10.9	14.8	7.7	1.6	0.4	0.1							
117	46.06	0.9	6.9	14.7	11.3	4.1	0.7	0.2							
119	46.85	0.5	4.1	12.5	14.3	6.9	1.8	0.2	0.1	0.1					
121	47.64	0.2	2.2	9.1	15.0	10.3	3 7	0.7	0.2	0.1	0.1				
123	48.43		0.9	5.9	3.5	12.9	6.0	1.8	0.5	0.2	0.1	0.1			
125	49.21		0.3	3.4	10.5	13.8	8.8	3.1	0.8	0.2	0.1				
127	50.00		0.3	11.8	7.9	13.9	11.1	6.0	1.9	0.7	0 2				
129	50.79		0.1	0.7	4.8	12.0	12.8	8.5	3.5	1.0	0.2				
131	51.57			0.3	2.7	9.2	12.7	9.6	5.3	1.6	0.4				
133	52.37			0.2	1.5	6.3	12.3	12.0	7.7	2.8	0.8	0.1			
135	53.15				0.7	3.5	10.5	13.5	10.5	4.8	1.2	0.3			
137	53.94				0.4	2.0	7.6	11.9	10.8	6.1	2.5	0.6	0.1	0.2	
139	44.72				0.1	1.0	5.0	10.4	12.5	8.8	3.6	1.5	0.4		
141	55.51				0.1	0.4	3.1	8.6	11.3	10.1	5.2	2.2	0.4		
143	56.30					0.3	1.8	5.3	9.9	10.8	5.6	2.2	0.7		
145	57.09					0.1	0.7	3.2	7.7	10.5	8.0	3.2	0.7	0.3	
147	57.87					0.1	0.4	2.1	5.9	9.3	9.1	4.2	0 8	0.3	
149	58.66						0.3	1.2	4.3	8.6	10.0	6.1	2.3	0.3	0.4
151	59.45						0.1	0.7	2.7	6.3	8.2	7.3	2.8	0.7	0.4
153	60.24							0.3	1.8	5.3	8.8	7.6	2.7	1.4	0.9
155	61.02							0.1	1.2	4.9	8.3	7.8	4.9	1.6	2.2
157	61.81							0.1	0.6	3.1	6.2	8.2	5.8	3.9	1.8
159	62.60							0.1	0.5	1.7	5.7	8.6	8.0	5.4	2.6
161	63.39								0.2	1.1	4.7	8.1	8.4	5.8	3.9
163	64.17								0.1	0.7	3.7	6.6	10.5	8.9	9.2
165	64.96									0.4	2.4	6.9	10.1	11.4	9.2
167	65.75									0.2	1.5	6.0	10.2	10.3	10.5
169	66.54									0.3	1.4	4.7	10.5	10.5	10.9
171	67.32									0.1	0.9	3.3	8.6	9.6	13.5
173	68.11										0.5	2.0	4.5	9.3	9.6
175	68.90										0.2	1.1	3.0	7.2	8.3
177	69.68										0.2	0.6	2.7	5.1	5.2
179	70.47										0.1	0.4	1.2	4.2	4.8
181	71.26											0.1	0.5	2.3	6.1
183	72.05												0.1	0.5	
185	72.83												0.1	0.5	
187	73.62														0.4
189	74.41													0.3	
No. of Boys,		1,535	3,975	5,379	5,633	5,531	5,151	4,759	4,205	3,573	2,518	1,481	753	429	229
Corrected Mean Variation (cm.).		4.80	4.92	5.22	5.53	5.66	5.90	6.32	6.80	7.71	8.66	8.87	7.75	7.23	6.74

Table K.

Showing the Frequency of Stature of Girls of Different Ages Mathematically Calculated by Dr. Franz Boas from the Data Furnished by the Measurement of 43,298 Girls in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland (Cal.). (Adapted from centimeters to inches.)

Age in Years.		5.611	6.545	7.513	8.501	9.497	10.495	11.494	12.490	13.479	14.471	15.466	16.473	17.466
Cm.	Inches.													
91	35.83	0.1	0.1											
93	36.61	0.9	0.1											
95	37.40	2.2	0.1											
97	38.19	4.6	0.6											
99	38.98	9.4	1.5		0.1									
101	39.76	12.3	3.5	0.3	0.1	0.1								
103	40.55	17.1	6.7	1.3	0.1	0.1								
105	41.34	16.8	10.2	2.5	0.3	0.1								
107	42.13	13.9	13.9	4.3	0.6	0.3	0.1							
109	42.91	11.1	17.1	8.3	2.0	0.1	0.1							
111	43.70	6.0	14.8	11.4	3.8	0.4	0.1							
113	44.49	2.9	11.3	13.0	6.0	1.2	0.2	0.1	0.1					
115	45.28	1.9	9.1	15.4	9.3	2.8	0.5	0.2	0.1					
117	46.06	0.4	6.0	13.3	11.8	4.7	1.1	0.2	0.1	0.1				
119	46.85	0.1	2.7	12.0	14.4	7.9	2.4	0.4	0.1	0.1				
121	47.64	0.2	1.3	9.0	14.2	11.0	4.3	1.2	0.3	0.1				
123	48.43		0.5	4.5	12.5	13.2	6.3	1.9	0.4	0.1				
125	49.21		0.2	2.8	9.9	14.2	9.5	3.2	0.7	0.1	0.1			
127	50.00		0.1	1.1	6.9	14.0	11.2	5.4	1.4	0.2	0.1			
129	50.79		0.1	0 5	2.4	11.1	13.2	7.9	2.6	0.4	0.1			
131	51.57			0.2	2.1	7.9	13.0	10.1	3.9	0.8	0.2			
133	52.37			0.1	0.9	4.7	11.7	11.7	5.6	1.3	0.4			
135	53.15				0.4	3.0	9.2	11.7	7.5	2.6	0.6			
137	53.94				0.3	1.7	6.7	10.4	9.1	4.4	0.9	0.2		
139	54.72				0.1	1.0	4.4	10.4	10.4	5.6	1.7	0.7	0.2	
141	55.51					0.3	2.8	8.3	11.4	6.5	2.6	0.7	0.2	0.1
143	56.30					0.1	1.7	6.0	10.3	7.8	3.5	1.5	0.8	0.3
145	57.09					0.1	0.7	4.2	9.0	10.8	5.6	2.6	2.0	1.0
147	57.87						0.4	2.6	7.2	9.3	7.0	3.8	2.6	2.4
149	58.66						0.2	2.1	6.2	11.2	10.2	7.8	5.4	4.4
151	59.45						0.1	1.0	4.8	10.5	12.4	10.2	8.2	6 7
153	60.24							0.4	3.4	8.4	12.8	12.1	11.0	8.4
155	61.02							0.3	2.4	7.6	13.4	15.3	12.9	10.8
157	61.81						0.1	0.2	1.6	4.9	9.3	11.8	12.7	16.1
159	62.60							0.1	0.8	3.4	7.4	11.2	13.8	13.5
161	63.39								0.3	2.0	5.1	8.9	11.3	13.8
163	64.17								0.1	1.0	3.0	5.9	7.3	7.1
165	64.96								0.1	0.4	1.9	3.5	5.8	7.1
167	65.75								0.1	0.2	0.8	2.2	2.9	3.5
169	66.54									0.1	0.5	0.7	1.4	2.4
171	67.32									0.1	0.2	0.5	1.2	1.1
173	68.11										0.2	0.2	0.2	0.5
175	68.90											0.2		0.8
177	69.68												0.1	
179	70.47													
No. of Girls,		1,260	3,618	4,913	5,289	5,132	4,827	4,507	4,187	3,411	2,537	1,656	1,171	790
Corrected Mean Variation (cm.).		4.64	5.97	5.25	5.58	5.73	6.18	6.83	7.57	7.37	6.69	5.96	5.79	5.75

data on height in the six American cities—Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland. The figures in the body of the tables give the percentages of boys or girls at the ages (shown at the top of each column) who are of the heights indicated in the column at the left. An addition has been made in the original table of Dr. Boas by expressing the heights in inches as well as in centimeters. Each given height is meant to include two centimeters; thus in the first line the percentages are for the heights 91 cm. to 92.99 cm., the second line for the heights 93 to 94.99, and so on. Thus, for example, the column for boys of 5.589 years shows that .4 per cent. of the 1,535 boys between 5 and 6 years measure 35.83 to 36.61 inches in height, .6 per cent. measure 36.61 to 37.40 inches, and so on down to the smallest boys, .2 per cent. of whom measure 47.64 to 48.43 inches. These tables, therefore, give a ready reference for determining the variations of individuals.

TABLE D.

Showing the Individual Yearly Height and Absolute Annual Increases of Dr. Wiener's Four Sons from Birth to 25 Years. (Centimeters.)

	First Born.	Second Born.	Third Born.	Fourth Born. Different Mother.	Annual Absolute Increase.			
					First Born.	Second Born.	Third Born.	Fourth Born.
Birth	54.0	46.0	52.4	55.0				
1	71.7	70.8	74.2	74.0	17.7	24.8	21.8	19.0
2	84.6	83.8	86.4	85.9	12.9	13.0	12.2	11.9
3	93.1	92.3	94.2	95.3	8.5	8.5	7.8	9.4
4	100.1	100.5	101.9	104.2	7.0	8.2	7.7	8.9
5	106.4	108.0	108.0	111.2	6.3	7.5	6.1	6.9
6	113.7	114.0	114.5	116.7	7.3	6.0	6.5	5.6
7	119.8	119.6	120.4	124.0	6.1	5.6	5.9	7.3
8	125.2	125.0	125.7	130.4	5.4	5.4	5.3	6.4
9	130.5	130.3	131.1	136.3	5.3	5.3	5.4	5.9
10	134.8	134.8	136.7	141.4	4.3	4.5	5.6	5.1
11	140.7	140.6	142.2	146.0	5.9	5.8	5.5	4.6
12	146.2	146.3	145.2	152.9	5.5	5.7	3.0	6.9
13	154.7	153.2	151.9	162.8	8.5	6.9	6.7	9.9
14	164.2	161.4	157.1	168.2	9.5	8.2	5.2	5.4
15	169.0	169.1	166.5	175.0	4.8	7.7	9.4	6.8
16	171.4	173.3	172.2	178.3	2.4	4.2	5.7	3.3
17	172.7	175.1	175.7	179.8	1.3	1.8	3.5	1.5
18	172.8	176.3	176.6	180.3	0.1	1.2	0.9	0.5
19	172.9	176.5	177.5	180.7	0.1	0.2	0.9	0.4
20	172.9	176.6	177.8	180.9	0.0	0.1	0.3	0.2
25	173.2	176.7	178.2		0.3	0.02		

As an interesting comparison with general averages computed from masses of children, the above table of the

growth in height of four individuals, from birth to manhood, are taken from a study by Dr. Christian Wiener of Karlsruhe.

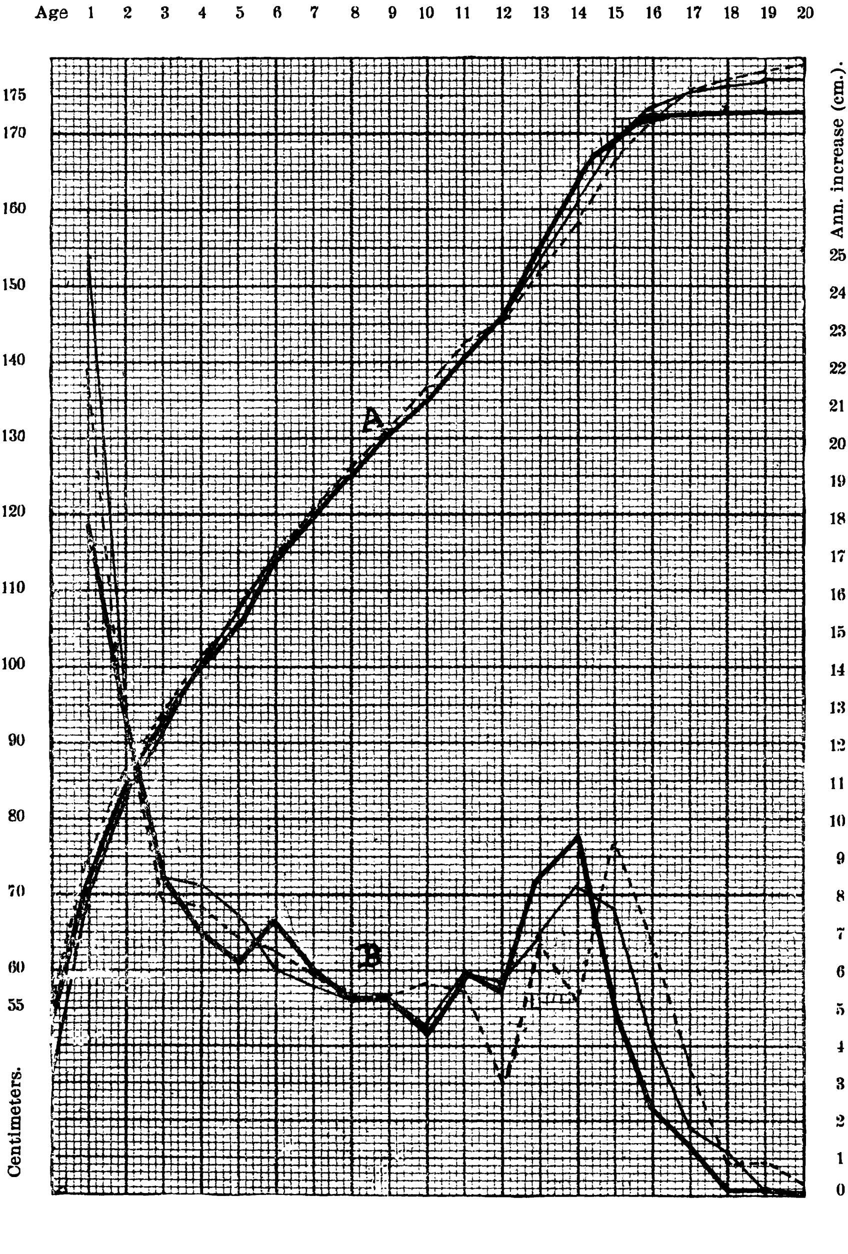
They are the measurements of the four sons of Dr. Wiener taken by himself.[1] The fourth-born son is by a different mother than the first three. The second wife was 5.1 centimeters taller than the first, and her child was born in her 36th year, while the first three sons were born in the 22d, 23d and 28th years respectively of their mother's life. The original measurements were taken not always exactly upon the birthdays, and the figures given, in order to make comparison available, have been computed to exact birthdays. The differences in time were generally so slight that the value of the figures is in no way affected.

The facts of these individual variations raise the important question whether or not the aim of training should be to make the child grow to specific dimensions. May it not be that each organism has ordained for it, we might say, by determined hereditary factors a particular size? This, however, is not the underlying principle of existing theories and practices in physical culture. The work of physical culture, as a rule, proceeds upon the assumption that there is an average size, and it should be our aim to approximate the average size or average proportion. In our gymnasiums our growing young people are measured. If the individual exceeds or falls short from the standard, specific exercises are given to develop this spot, to reduce that, and so forth. May, after all, this be all wrong? As will be later suggested by phenomena of growth, there is evidence that every organism seems to have a particular size, which it struggles desperately to attain. If we wish to speculate with Weismann, we may conceive that in the fertilized egg, the determinants have already, by hereditary forces, decided just the size and just the proportion each organism specifically ought to have. This decision is reached by natural selection within the egg. If in the growing period, by virtue of poor nutrition, disease, lack of exercise, or any other accident, any part of this organism fails to reach predetermined proportions, then there will be disharmony and lack of proper proportion. In so far will there be interference, for the parts will not exactly fit. Up to this point, we find ourselves in agreement with the ruling principle of physical development. But, upon the assumption of a particular size, is the physician or any one to determine by any tests of measurements what part should be developed or what reduced? The particular may vary from the "average" or the mean, and yet be entirely normal for that

[1]Other tables of individual growth, in weight as well as in height, will be found given by Camerer.(23)

CHART IV.

Showing curves of growth (A) of Dr. Wiener's three oldest sons; also curves (B) of Absolute Annual Increases in inches taken from Table D. Heavy line in both A and B, eldest son; light line, second son; dotted line, third son. Figures are in centimeters; those on left apply to curves A, those on right to curves B.



individual. By artificial development, may we not do for the individual just what disease or mal-nutrition is supposed to do—to destroy the particular proportion? This view is not put forth as a theory, but in the light of further treatment as an alternative view deserving consideration.

DAILY, WEEKLY AND SEASONAL RHYTHMS OF GROWTH.

We have considered the increases in physical structure for the whole growing period, and have seen that the rate is by no means continuous and constant; but is broken up into a number of rhythms, as it were, rapid periods and then slower periods. It remains to consider the rate during a single year. Here, again, the view until very recent years has been the accepted notion that for this period, at least, the rate was constant. It was only a few years ago that Wretlind in Denmark weighed children before and after the three months' vacation, which occurred from July to September, and finding that the rate of increase during this period was more rapid than during the other nine months of the year, jumped to the conclusion that the injurious influences of attendance at school accounted for it. The chief contribution to this phase of the problem has been by R. Malling-Hansen, director of the Deaf and Dumb Institute at Copenhagen. He has weighed and measured his pupils, and in his three contributions on the subject has presented a mass of detailed information and some very suggestive causal theories. He finds three general seasonal periods during the year for height and the same number for weight; weekly variations, daily variations, and also a slighter rhythm, seemingly dependent upon the solar month.

The pupils of the school, 130 in number, were between the ages of 9 and 17. Nearly all of his tables in *Perioden im Gewicht der Kinder und in der Sonnenwärme*, are based upon measurements and weighings of about 70 boys, weighed from May, 1882, to February, 1886, and measured from February, 1884, to February, 1886; the children were weighed four times a day, with the exception of the vacation time from the middle of July to the end of August. The pupils were weighed in groups of sixteen to eighteen, and the heights given are similarly those of groups. His data therefore show nothing regarding individuals.

The most important of Malling-Hansen's contributions is that concerning seasonal growths. From his careful measurements of about 70 boys for two years, and weighings for three years, he concludes (†[64]): "The weight of a 9 to 15 year-old boy has three periods of growth during the year—a maximal, a middle, and a minimal. The maximal period begins

([64]) P. 29.

in August and concludes in the middle of December, lasting, therefore, four and one-half months. The middle period extends from the middle of December to the end of April, four and one-half months. The minimal period extends from the end of April to the end of July, therefore three months. During the maximal period the rate of increase in weight is three times as great as in the middle period. Almost the whole weight gained in the middle period is lost during the minimal period."

Respecting height he finds similar rhythms of growth, a maximal, a middle and a minimal period. "The minimal period begins in August and lasts until the middle of November, three and one-half months. The middle period reaches from the end of November till the end of March, about four months. The maximal period extends from the end of March until the middle of August, about four and one-half months. The daily rate of growth is two and one-half times as great, and that of the middle period twice as great, as that of the minimal period."

Approximately, it is to be observed, the period of maximal growth in weight, the autumn, is the period of minimal growth of height; and in spring and summer, while the body is growing most rapidly in height, it is actually losing in weight.

Malling-Hansen finds that children increase in weight and decrease in height by day, and increase in height and decrease in weight by night. In boys of 13 to 16 years, this increase or decrease can be as much as 10 millimeters, and a loss of .57 kilograms in weight during the night. The weekly variations are dependent upon local conditions, to a large extent due to variation or appetite.

Malling-Hansen has also given a body of facts and a very suggestive theory regarding the influence of temperature upon growth in weight and probably upon height. He finds that whenever there is an increase in atmospheric heat, there is also an increase in weight of the children weighed, and when the atmospheric temperature sinks, the rate of growth sinks. The correspondence is not, however, proportional in amount. At great labor and length, he gives tables of the temperature in various parts of the world for identical periods, and finds slight rhythms in the rise and fall of the atmospheric temperature; and thereupon offers as a cause an elaborate theory that the rotation of the sun upon its axis, thereby presenting different portions of its surface towards the earth, some of which radiate more heat than others, affects the growth in the animate world rhythmically. The periods are of about 25 or 26 days, within which are briefer periods of

maximal and minimal radiations of growth energy. He claims to show these effects, not only in growth of children, but in other physiological phenomena of adults, especially in women. His charts ([64]), explaining the theory, give details strikingly forcible in support of his theory.

Camerer* weighed a youth of 17 years, a boy of 8 years and an infant of six weeks several times during twenty-four hours, and also carefully weighed the food and excrement. He finds fluctuations in the youth of about one kilogram during the day; in the boy about .65 kilogram, and in the infant about .2 kilogram. The curves are strikingly alike in the three cases, rising in rhythms with slighter falling fluctuations from morning till evening; during the night the gain of the day is lost. Camerer corroborates Malling-Hansen also in the facts of the seasonal fluctuations, but declines to accept the meteorological explanation offered by the latter.

Dr. M. Vahl, of the school for homeless girls at Jagerpris in Denmark, weighed the pupils twice a year, on April 1 and October 1, from 1874 to 1883 inclusive. His results show that the increase in weight in the summer half year is about 33 per cent. greater than during the winter half year.

Vierordt ([†93]) offers some corroborative data in a table constructed from weights of children in first year, contributed by Fleischmann, Ahlfeld, Hesse, and Holmer. Distinct rhythms of growth in cycles approximating a week are shown. Fleischmann comments as follows: "If one weighs children weekly, he will be surprised at peculiar variations of increase. There is a period of rapid growth followed by a weaker period. This change is striking, and repeats itself weekly or half-weekly, so that in quite healthy children there is a continual fluctuation. What forces are operating are to me undiscoverable."

Combe in Lusanne studied the question whether or not the season of the year in which children are born affects their subsequent rates of growth. His tables follow the growth in height of children, segregated according to the month of the year in which they were born. He concludes that the rate (*i. e.*, determined by annual increments) is not affected, but that the height at any given age is very materially influenced. Boys born from September to February are shorter than those born from March to August; while in the case of girls, December to May inclusive are the unfavorable

---

* An earlier publication by this author, "*Der Stoffweechsel-eines Kind in ersten Lebensjahre*" (*Zts. f. Biologie*, 1878) gives data on daily fluctuations more fully.

([93]) P. 247.

months for birth. The difference of the averages is slight, but nevertheless perceptible. This conclusion which Combe finds is interesting in connection with Malling-Hansen's principle of seasonal growths.

Factors of Variation in Growth.

Some of the factors which have been put forth as influencing variations in growth, aside from those of age and sex, have been race, social and nutritional environment, occupation, climate, exercise and density of population. That some children are taller and heavier than other classes, either in the same or different localities, has been demonstrated; but exactly to what factors these variations are to be definitely attributed is a matter as yet far from conclusive solution. The problem in whatever form it occurs is always a highly complex one, making it difficult to segregate causes clearly.

Nutrition.—The view that growth in some degree is determined by nurturing environment is an old one, and existed before any careful and general statistics had been made. Villerme in 1829 concluded that stature is greater and the growth sooner completed, all other things being equal, in proportion as the country is richer and the comforts of the inhabitants more general. Quetelet later assumes and emphasizes this view and Cowell (†[26]) in England, from an investigation in 1833 of 1,062 factory children, and 228 others in more favored conditions, draws a similar conclusion. Boudin in France, from his studies of height and weight of different races, chiefly from military statistics, concluded that stature is to a great extent "independent of comfort and misery, and is on the contrary closely connected with race." Donaldson (†[29]), from the data in Roberts' Anthropometry, thinks that "the environment has more influence upon males than upon females." Porter (†[78]) in St. Louis is inclined to conclude that "a wide difference in social station and material prosperity may exist, without much influencing the growth up to the prepubertal acceleration," and Key (†[59]) goes so far as to say from comparison of curves of development in America, England and Sweden that "the weak period of development before puberty is lengthened for the poorer children to their cost. . . . The period of accelerated development is made later for them, but once commenced passes more quickly, and what is very surprising is completed generally in the same year as that of well-to-do children. The whole period is shorter for poor children, but there is a

---

(26) Cowell's table will be found in Bowditch's "Growth of Children," p. 78.

(29) P. 59. (78) P. 309. (59) P. 87.

stronger increase during the last year of the period." Roberts, from his comparison of data upon the favored and the artisan classes of England, says, "With the accession of puberty there is an increased rate of growth in the non-laboring classes, and an entire cessation of it at the age of 19 or 20 years; while in the artisan classes the growth is more uniform and extends to about the 23d year."

But such conclusions as these, upon a basis of actual measurements thus far made, are only valuable as suggestions. The conditions of actual data are yet far from absolutely justifying such sharply defined results.

General anthropometrical measurements upon adults with reference to the influences of race and nutrition have received important study by Drs. J. H. Baxter and B. A. Gould. Both find that American recruits are taller than those of European countries, and that natives of European countries who enlisted in American armies are taller than those who attained their growth in the lands of their nativity. Dr. Gould makes a forcible argument from statistics that this greater growth is attributable to the greater comfort of American life. Dr. Baxter, however, is inclined to minimize the influence of comfort and plenty.

In America the chief attempt to solve the problem of the influence of nutritional conditions upon growing children has been made by Dr. Bowditch of Boston. In the Eighth Annual Report, he deals with the problem more generally, but the Tenth Report is devoted chiefly to the factors of race and nutrition. In the Eighth Report, he gives a table of heights and weights of Boston boys attending certain schools, indicating the probability "that these pupils represent a class in

Age.	Height (inches).		Weight (lbs.).	
	Favored.	General.	Favored.	General.
10	53.51	51.68	70.6	65.36
11	54.96	53.33	75.3	70.18
12	56.78	55.11	85.9	76.92
13	59.60	57.21	94.4	84.84
14	61.51	59.88	99.9	94.91
15	64.20	62.36	116.6	107.10
16	65.83	65.00	125.8	121.01
17	67.44	66.16	135.2	127.49
18	67.44	66.66	138.2	132.55

the community corresponding sufficiently well in social conditions to that class in England which sends children to the public schools and universities." This table is given above

under heading of "Favored." Compared with the entries in these columns are the entries from the general averages of the entire Boston school population. It is clear at a glance that, at any given age, the boys from the favored classes are both heavier and taller than those of the general school population.

Bowditch constructs a table and curve of heights in relation to weight, and concludes from English data of Roberts that it would seem that "deprivation of the comforts of life has a greater tendency to diminish stature than the weight of a growing child." Bowditch's general tables indicate that children in Boston of American parentage are both taller and heavier, at a given age, than children of foreign parentage. He draws attention to the fact that the foreign population comes, as a rule, from the poorer European classes, and he concludes: "It is reasonable to assume that the superior size of children of American parentage in the Boston schools is due in part to the greater comfort in which they live and grow up, and in part to other conditions, which may be described collectively as differences of race and stock."

In the Tenth Report, Dr. Bowditch groups, in tables and curves, the children by sex and ages from 5 to 18 years, into the rubrics of those whose parents are laboring, and those whose parents are non-laboring, and also takes the two races represented—American and Irish—and groups each of these separately into those whose parents are non-laboring and laboring. His tables show, on the whole, though differences are usually small, that the children of the poorer classes, at a given age, are smaller than those of the classes which enjoy presumably better nutrition, and Bowditch finds it "safe to conclude that the importance of mode of life as a factor in determining the size of growing children in this community (Boston) is at least equal to, and possibly even greater, than that of race."

One of the most general investigations bearing upon the effects of favorable and unfavorable influences is that of Roberts in England, detailed in his Anthropometry. He gives tables showing height, weight and chest girths of 7,709 males between the ages of 10 and 30 years, representing the most favored population of England—public school boys, military cadets, medical and university students. To be compared with these are tables showing the same facts from 13,931 males, between the ages of 4 and 50 years, belonging to the artisan class of England. Roberts concludes that the prepubertal growth begins in the favored classes a year or two earlier than in the laboring classes, and that there is "both a higher mean height and a wider range from tallest to shortest

among favored classes. . . . During the periods over which the observations extend, the most favored class has a mean height of about two inches greater than that of the industrial classes, but it is probable that if the observations were extended to the time of birth, they would gradually approximate." A second series of tables constitutes comparisons between boys and men from the professional, commercial, industrial classes, idiots and imbeciles, and Americans. The comparisons are generally in accord with those above indicated. The favored classes at any given age are very perceptibly heavier and taller on the average than those of the less favored classes.

The Anthropometric Committee of England, in its report [37] of 1883, presents data of height from 37,374 males and 1,616 females; and of weight from 33,043 males and 4,685 females of England, from birth to 70 years of age. By tables these data are segregated into four classes: professional, commercial, laboring (country), and town artisans. The data for the females when classified are of little value, owing to smallness of the numbers considered. The facts, however, generally indicate the conclusions that at any given age the professional classes are both taller and heavier than the less favored classes. Of special interest in this matter is a table of the growth in height and weight of 1,273 boys and 601 girls under 16 years of age, inmates of the Swinton Industrial School of England. They therefore represent the most unfavorable conditions of life and heredity. Compared with boys of Roberts' most favored class of England, these industrial school boys are, at 10 years of age, 3.31 inches shorter and 10.64 pounds lighter; at 14, 6.65 inches shorter and 21.85 pounds lighter.

Geissler and Uhlitsche compare the heights of children of the Freiburg Burgerschule with those of the children of the peasant classes in the surrounding country. The former live under relatively more favored conditions. For the ages given, the Burgerschule children are distinctively taller. The following table shows the differences in favor of the Burgerschule pupils at each age in centimeters:

Age,	6½	7	8	9	10	11	12	13
Boys,	2.4	2.7	2.3	5.1	2.7	2.3	3.8	4.7
Girls,	3.9	3.6	2.8	3.8	4.5	3.9	3.1	5.1

The compilers compare the heights of each class with the general average obtained, and feel justified in concluding, "The children of the peasant families are on the average, without exception, smaller and the children of the Burgerschule larger than the average of the whole. This fact stands

even when the corrections of probable error are applied. One may therefore perhaps assume that the different social conditions under which children live influence essentially their physical development."

Geissler in Gohlis-Leipzig separates the data of height and weight of children of a Burgerschule paying 18 marks from another paying 9 marks—a fact which the compiler considers basis for distinguishing the richer from the poorer classes. He does not give the tables, but summarizes his findings as follows: "The differences in height for boys of similar ages vary in favor of the richer class from 0.7 to 4.0 centimeters, and in weight between 7.3 and 4.7 pounds (German); with girls from 1.7 to 4.1 centimeters in height, and in weight between 1.6 and 4.6 pounds (German).

The Danish Commission (51) gave the subject of social and nutritive conditions some attention. Hertel (53) gives a table for boys and girls of 11, 12, 13 and 14 years. It shows that the boys of the Gymnasia, presumably representing the more favored classes, are slightly taller and heavier than the boys of the Real and Bürger schools, and the boys of the Real schools are taller and heavier as a rule than those of the Burger schools. These differences, varying up to an inch or two in height and to a pound in weight, are more distinct in earlier ages than at 14 years. In the Volkschulen, however, there is no essential difference between the boys who attend schools requiring tuition and those attending free schools, but the sons of the "Bauer" class (small country farmers) are taller and slightly heavier than the sons of "Arbeitern" (artisans). Among the girls of the ages as given, those in the higher girls' schools (the more favored class) are an inch, or less, taller; and heavier from no difference at 11 years to about 3 pounds at 14 years. In the girls of the Volksschulen, those who pay are heavier and taller (the difference increasing with age) than those who do not, and the daughters of the "Bauer" class have a slight advantage over the children of the "Arbeitern."

Erismann, quoting investigations of Michailoff upon comparisons of physical development of children in the city schools of Moscow, of village schools, and factory children, shows superiority in height of the Moscow boys in school over the factory boys as follows (in centimeters):

Age,	9	10	11	12	13	14	15	16	17
Boys,	.4	4.6	5.7	5.7	7.7	9.0	9.7	8.7	5.4

But, strangely, the factory girl exceeds the school girl in height until the age of 14, but at this age and later falls very significantly behind. The height of the two classes is here given in centimeters.

Age.	School Girls.	Factory Girls.
7	111.6	.....
8	116.4	118.8
9	119.6	123.6
10	125.0	129.5
11	129.7	131.0
12	132.9	135.5
13	138.3	139.9
14	145.8	143.4
15	146.4	148.2
16	150.3	151.0
17	.....	152.4
18	.....	152.8

The heights of factory boys at 8 years (based on less than 100 cases) are 2.3 centimeters greater than those of the school boys. The same general relation appears in the weights. Up to 11 years the school boys are shorter than the factory boys (the number of the latter is less than 100 for the years of 10 and 11) until 11 years, but after that age the school boys are taller by the following differences (in centimeters):

Age,	11	12	13	14	15	16	17	18
Boys,	1.12	2.21	6.06	5.79	6.70	8.5	7.8	5.4

The data for comparison of school girls with factory girls are not given; but city school girls, as well as boys, very significantly exceed village school girls and boys from 8 years through the 13th year (as far as data are given for the village children). In breast circumference the factory children, both boys and girls, slightly exceed the city school children at 8 to 12 years inclusive (data prior to 8 years not given), but after 12 years until 20 they are very slightly smaller.

Key (58) compares children attending the preparatory and middle schools of Stockholm with those of the Volksschulen, the former representing the more favored classes and the latter the poorer classes. The differences in favor of the better nourished children (indicated by the + sign) are given as follows (— indicates a difference in favor of the poorer classes):

HEIGHT.

Age,	7	8	9	10	11	12	13	14	15
Boys (cm.),	+4	+4	+6	+4	+2	+3	+2	+5	+4
Girls (cm.),	—1	+2	+2	+2	+3	+3	+2	+2	+3

WEIGHT.

Boys (kg.),	+0.3	+0.4	+3.0	+1.6	—1.4	+1.5	+1.6	+5.3	
Girls (kg.),	—0.6	+1.8	+1.4	+1.4	+1.4	+2.0	+1.9	+3.5	+2.9

Pagliani compares the weights of girls in a private school near Turin, Italy, with those of charity girls in the city. At 15 years the charity girls are 37.1 kilograms in weight and the school girls 45.6 kg. Stature also shows a difference against the charity girls.

The data as detailed seem clearly to justify the conclusion that, at any specified age (data are absent for ages under 6 or 7 years), children of both sexes, who live in conditions of more favorable nurture, are, on the average, both taller and heavier than those of less favored nutritional conditions. Our data upon this subject are extremely weak for ages under 10 years, and clearly many more numerous and more careful studies are needed before the principle involved will be cleared. But the question as to the *rate* of growth relatively in the favored and unfavored classes places our data under a new aspect. It is of importance to know at what period of growth favorable or unfavorable environment most affects growth as shown by the rate. It is evident that while the children in unfavored conditions may at any given age be actually smaller than those of the favored classes, yet they may make, nevertheless, a more rapid rate of growth. This will be clear by an example. Bowditch's girls of Irish parentage in Boston from the non-laboring classes are in height at 6 years 111.1 cm., while those of the laboring class average but 109.1 cm.; at 10 years the non-laboring class measures 131.7, the laboring 129.7; at 17 years the non-laboring are 156.2 cm., the laboring 155.7. The girls from the non-laboring classes exceed the girls from the laboring classes by 2 cm. at 6 years, 2 cm. at 10 years, .5 cm. at 17, and at every age, indeed, the table shows they are taller. Yet if we subtract the height of each class at 6 from the height at 10, we get in each case 20.6 cm., showing that for these four years the two classes made the same actual increment of growth. The apparent difference between them is due to the fact that at 6 years the girls from the laboring classes already were smaller. Now, if in the same way we subtract the height of each class at 10 years from their heights at 17, we find that in this period of seven years the non-laboring classes have grown 24.5 cm., while those of the laboring classes have grown 26 cm. In other words, while at each age the unfavored class is smaller, yet they have actually grown 1.5 cm. more than the favored class. Their rate has been more rapid. The differences at the different years is due to the fact that the unfavored class were smaller to begin with, that is, at 10 or 6 years. Reducing this rate to percentage form, we may say that the girls from the non-laboring classes grew 18.5 per cent. of their height at 6 years in the four ensuing years,

while those of the laboring class grew 18.8 of their average height at 6. From 10 to 17 years the favored class grew 18.6 per cent. of their height at 10 years, and the unfavored class grew 20 per cent. of their height at 10. Did all data bear out this ratio, we should conclude that children under poor nutritive conditions grow faster from 6 to 17 years than children from the favored class, and that the conditions which poor nutrition affect must lie in the early years of childhood or embryonic life. Indeed, on the whole, the data will point to a possible conclusion of this kind. If, now, we take the same data that have been reviewed and calculate the percentage rate of growth, we are not able to conclude so definitely that the child of favorable conditions always grows faster than the child of unfavorable conditions. There seems to be very little difference in the two rates on a whole, and the children of the unfavored classes in height exceed those of the favored classes in percentage rate more than the reverse. In weight increases, however, the coincidence is pretty clear that poor nutrition steadily lessens the rate of growth. As a rule the results are based upon such small numbers that the figures are not of assuring value. We may take Bowditch's figures from the Tenth Report for an illustration, and the following tables are calculated from the different classes represented, both as to height and weight:

TABLE J.

Showing the Rates of Growth of Favored and Unfavored Classes, Calculated from Bowditch of Boston.

BOYS OF BOSTON.	Height at 6 years. cm.	Height at 10 Years. cm.	Height at 17 Years. cm.	Absolute Increase. 6-10 Yrs. cm.	Absolute Increase. 10-17 Yrs. cm.	Per Cent. Increase. 6-10 Yrs.	Per Cent. Increase. 10-17 Yrs.
American—							
Non-laboring Class,	113.0	133.0	168.7	20.0	35.7	17.6	26.8
Laboring Class,	111.5	132.0	167.6	20.5	35.6	18.4	26.9
Irish—							
Non-laboring Class,	110.8	131.5	165.1	20.7	33.6	18.7	25.5
Laboring Class,	111.2	131.0	168.5	19.8	37.5	17.8	28.6
Irrespective of Nationality — Non-laboring,	112.1	132.5	168.1	20.4	35.6	18.2	24.6
Laboring,	111.2	131.0	167.1	19.8	36.1	17.8	27.5

Girls of Boston.	Height at 6 Years. cm.	Height at 10 Years. cm.	Height at 17 Years. cm.	Absolute Increase. 6-10 Yrs. cm.	Absolute Increase. 10-17 Yrs. cm.	Per Cent. Increase. 6-10 Yrs.	Per Cent. Increase. 10-17 Yrs.
American— Non-laboring Class,	113.4	131.8	157.6	18.4	25.8	16.2	19.6
Laboring Class,	110.4	131.5	157.5	21.1	26.0	19.2	19.8
Irish— Non-laboring Class,	111.1	131.7	156.2	20.6	24.5	18.5	18.6
Laboring Class,	109.9	129.7	155.7	19.8	26.0	18.0	20.0
Irrespective of Nationality—Non-laboring,	112.1	131.3	157.3	19.1	26.0	17.0	19.8
Laboring,	109.9	130.3	157.4	20.4	27.1	18.5	20.8

Boys of Boston.	Weight at 6 Years. lbs.	Weight at 10 Years. lbs.	Weight at 17 Years. lbs.	Absolute Increase. 6-10 Yrs. lbs.	Absolute Increase. 10-17 Yrs. lbs.	Per Cent. Increase. 6-10 Yrs.	Per Cent. Increase. 10-17 Yrs.
American— Non-laboring Class,	45.61	66.05	129.2	20.44	63.15	44.8	95.6
Laboring Class,	44.81	66.38	128.6	21.57	62.22	48.1	93.8
Irish— Non-laboring Class,	45.33	67.37	119.15	22.04	51.78	48.7	76.9
Laboring Class,	45.25	64.70	124.5	19.45	59.85	42.9	92.5
Irrespective of Nationality—Non-laboring,	45.50	65.31	128.23	19.81	62.92	43.5	96.3
Laboring,	45.06	64.89	125.28	19.83	60.40	43.9	93.0
Girls of Boston.							
American— Non-laboring Class,	44.43	64.78	116.3	20.35	51.52	45.8	79.5
Laboring Class,	43.47	63.47	115.14	20.00	51.67	46.0	81.4
Irish— Non-laboring Class,	44.05	63.64	110.75	19.59	47.11	44.5	74.7
Laboring Class,	43.15	61.35	121.8	18.20	60.45	42.2	98.5
Irrespective of Nationality —Non-laboring,	44.14	63.76	115.15	19.62	51.39	44.4	80.6
Laboring,	43.13	61.98	115.72	18.85	53.74	43.7	86.7

It is evident that the data give no certain evidence of an increase in rate with better nutrition, though at any given age there is a difference. In the majority of cases, where there is any material difference in rate indicated, the children of poorer nutrition grow faster.

Roberts' comparison between the favored and unfavored classes of England at any given age indicate very significant differences to the advantage of the former. At 10 years, the average of the favored classes is 2.88 inches taller, 1.09 pounds heavier, and 3.61 inches greater in chest girth. At 17 the average of the favored class is 3.39 inches taller, 31.6 pounds heavier, and 4.60 inches greater in chest girth. Yet if we take into consideration the actual sizes of both classes at 10 years, the increases except for weight are not significantly greater. Thus:

	Height Increase. 10-17 Years.	Chest Increase (empty). 10-17 Years.	Weight Increase. 10-17 Years.
Favored,	14.4	5.4	80.6
Artisan,	14.2	4.5	50.1

From Key's tables, instituting a comparison between the favored classes in the middle and preparatory schools and the poorer classes in the Volkschulen, the data show the amount of growth for the two periods as follows:

	Height.		Weight.	
	6-10 Years.	10-17 Years.	6-10 Years.	10-17 Years.
Boys—				
Favored,	12 cm.	23 cm.	7.5 kg.	22.0 kg.
Poor,	12	23	6.2	15.6
Girls—				
Favored,	16	25	7.8	19.5
Poor,	13	24	7.8	18.0

The writer has similarly calculated the percentages of growth from 6 to 10, and 10 to a later age, as made possible by the data upon favored and unfavored classes, offered by the Anthropological Commission, Geissler and Uhlitzsch in Freiburg, Erismann in Moscow, and Hertel in Denmark. The results are by no means conclusive. In weight the evidence is stronger that poor nutrition retards the rate of growth, but the conflict of results suggests that factors other than those of nutrition enter, and that data must be first obtained free from such complications before the problem can be definitely solved. Perhaps the safer form of conclusion is that from ages 6 to 17 the rate of growth is not so distinctly affected by differences in nutrition as the actual divergence of size at any given age would suggest, and that of rates of increase in height and weight, the latter seems more susceptible of retardation due to this cause.

Porter [78] expresses a suggestive and important theory, if true, that differences due to social conditions have slight effect before the prepubertal acceleration.

Porter compared the weight of 2,000 girls, separated into the classes, daughters of professional men and merchants (655), and the daughters of artisans and laborers (1,345), of St. Louis. During the 7th and 8th years, the daughters of the artisans and laborers were heavier by .42 and .11 kilograms respectively, but at 8 years the daughters of the professional and mercantile classes gain the slight ascendency and maintain it by the following differences in kilograms:

Age,	8	9	10	11	12	13	14	15	16	17
	.11	.37	.15	1.18	1.58	1.97	2.09	1.87	.98	2.51

Porter's conclusion is not clearly supported by comparisons from other investigations. Though valuable as a tentative suggestion, it is as yet, in the condition of facts, premature.

Influence of different food stuffs: The influence of different foods upon growth has been submitted to an accurate experimental test by Malling-Hansen in a Deaf and Dumb Asylum of Copenhagen. It was, in fact, the purpose of the elaborate system of weighings, previously described, to determine the influence of various foods. On May 16, 1883, a change of diet at the asylum went into effect. The previous diet consisted largely of black bread and beer. The new substituted white bread and milk, and in other details made it considerably richer in albuminous food. Malling-Hansen compares the growth in weight under the two diets, for eight months, from September 11, 1882, to May 11, 1883, with the beer and black bread; and from September 11, 1883, to May 11, 1884, with white bread and milk. The 70 boys, in the aggregate, increased 105 pounds more under the new diet than under the old. But, Malling-Hansen points out, this increase was not distributed evenly over the eight months from May to December. On the contrary the curves of increase for the two years, under radically different foods, ran practically parallel for the six months and a half from November 22 to May 11. The whole increase took place in the month and a half from October 11th to November 22d. In the case of the girls the difference of increase, under the two forms of diet, was 76 pounds, and all this was gained in 32 days. As a conclusion Malling-Hansen is inclined to discredit any direct material influence of different foods upon growth, and to ascribe all direct causes of acceleration to internal forces.

Dr. C. Voit of Bavaria, in a brief monograph, enters a forcible criticism to Malling-Hansen's conclusion that difference in foods has nothing or very little to do with growth. He contends that weight is no true index of the essential pro-

cesses of growth. Increase in weight may be due (and he offers facts in proof) simply to greater absorption of water by the body, or by mere addition of fat. Only an exact chemical analysis could reveal the effects of the change in diet described by Malling-Hansen. The children may have been making essential increases in growth which the scales under certain circumstances would not reveal.

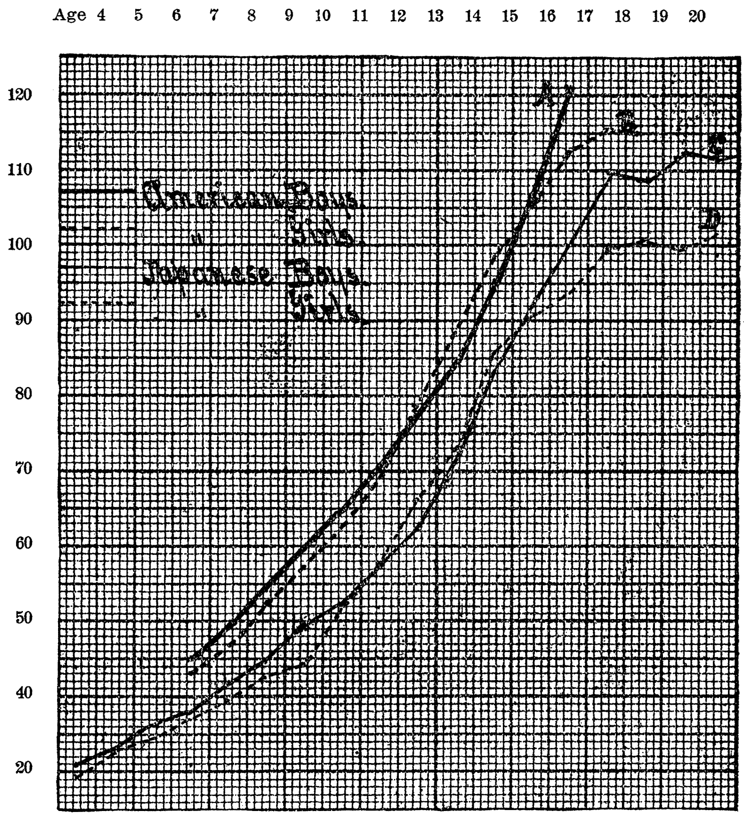
Boas ([13]) quotes Cartier as proving that children of unfavorable nutritional environment brought under favorable condition grow more rapidly than the rest, who are left in their former conditions.

The effect of different foods upon infants has been investigated by Russow ([84]) in Oldenburg Hospital. Some infants were nourished exclusively at the breast and others were given a mixed diet. At 15 days the average of the first class was 3,564 grammes and the last class 3,525 grammes. At the end of this year the infants nourished exclusively at the breast weighed on the average 9,930 grammes, and those on a mixed diet 8,480 grammes, showing a difference of weight of 1,450 grammes. The breast-nourished infants increased 150.7% of their weight at 15 days, and those of the mixed diet 140.7%, which is not a difference of striking suggestion in favor of the effects of superior nourishment. More conclusive is the evidence furnished by Camerer ([23]). Fifty-seven infants, all weighing over 2,750 grammes and averaging 3,450 grammes at birth, were fed at the breasts of mothers or nurses, and at the end of the first year averaged 9,889 grammes; on the other hand 31 infants, all weighing more than 2,750 grammes and averaging 3,221 grammes at birth, were nourished by artificial preparations, and at the end of the year averaged 9,954 grammes; the latter were, therefore, slightly lighter at birth and heavier at the end of the year. The curves of growth given by Camerer show in the middle of the year the breast-fed children were heavier, but he concludes that whatever the nourishment during the first year, nevertheless all children at the end of the year reach about the same weight. Of course, he means to except children who are very materially lighter at birth, for whom he gives separate tables. Eighteen cases of infants averaging 2,390 grammes at birth, fed upon a mixed diet of breast milk and artificial preparations, weigh on the average at the end of the year but 8,490 grammes, and 10 others averaging 1,630 grammes at birth, under a similar diet, reach 6,610 grammes at the end of the year. Camerer gives about fifty individual cases, tabulating weights by weeks, and there is no evidence of the effects of differences of food, judging from the compared results at the end of the first year. If anything, results favor artificial food.

Influences of Race: It is the general conviction of students of anthropometry that race, as a factor in determining growth, is one of significant if not of first importance. But the consideration of this problem leads further into the realms of pure anthropometry than a pedagogical study would justify.* There is little material in the investigations of growing children that sheds conclusive proof. In a general way, by com-

CHART V.

Comparing curves of growth in weight of average American boy and girl (taken from Table I) and of average Japanese boy and girl (taken from data of Dr. Miwa). Figures on left are in pounds.



* The Lowell Lectures by Professor W. Z. Ripley, published in the *Popular Science Monthy* during 1897, are particularly illuminating on this subject.

parisons of investigations of growth in different countries, given in the tables, it will be seen that at a given age American children are, as a rule, taller than European children, and that in Europe the Italians and Belgians are shortest Baxter and Gould, as already stated, have drawn important conclusions for growth under American conditions. Bowditch ([19]) gives the most comprehensive treatment relative to growing children, and inclines to the recognition of racial influences of considerable importance. Peckham follows the general plan of Bowditch's investigation, and finds that Milwaukee children of American parentage are about half an inch taller than children of German parentage. His tables would indicate that these racial differences are more pronounced after the tenth year, beginning with the prepubertal acceleration. Peckham can reach no conclusion regarding the influence of race upon weight. Porter, in St. Louis, finds no traces justifying a conclusion of considerable influence of race as a factor. Landsberger deals with the subject somewhat, finding up to the 10th year at least no appreciable differences between children of German parentage and Polish children. He criticises Bowditch's conclusions recognizing racial influence upon the children of Boston. The Report of the Anthropometrical Committee in England ([37]) gives considerable data, tables and charts indicating differences in size of the people in various parts of Great Britain and Ireland.

Bowditch reviews the statistics of Erismann in Russia and Pagliani in Italy, and concludes that Italian children are in early life very much smaller than American children; although they make a gain later, they never overtake Americans. The Russian factory children also are smaller throughout, but these children, of course, as Bowditch states, do not represent the typical Russian growth.

Climate: Climate as a separate factor exerting a direct influence upon growth in height and weight, has received comparatively little attention upon a statistical basis. Peckham briefly reviews the facts, and concludes "that climate has any considerable effect in modifying growth seems quite improbable. Theoretically, a low temperature ought to stunt men, since a large amount of energy would be expended in maintaining the bodily heat; and the further strain upon the digestive system to provide the large quantity of food necessary for this purpose would leave a smaller surplus for growth. The evidence, however, so far as we can disentangle it, does not justify this inference. Taking a wide survey of the facts, we find that the Western Esquimaux, the negroes of Guinea, the Australians, the Patagonians, the Kaffirs, all have an average height of over 170 centimeters. In Europe the non-

dependence of stature upon latitude is patent. For South America, D'Orbigny discarded the theory most emphatically. Dr. Baxter's table showing the order of superiority, by states, of American-born white men, is a remarkable series of observations for refuting the supposition."

The Anthropometric Committee's Report ([37]) of stature in different parts of Great Britain and Ireland deals extensively with this feature, and certainly shows significant variations with localities, but to conclude that climate is the determining factor is merely, of course, an hypothesis. Dr. Beddoe (†[4]), speaking of this fact, says: "The idea that climate, *per se*, has any influence upon stature is very little supported by our materials. At the first blush, we might be disposed to think that a northern position and a somewhat vigorous climate operated favorably probably by natural selection. Climate, where it does influence the growth of men, probably does so, either through natural selection or by affecting his food and mode of life." In America, the growth of children in various cities, as cited, shows different degrees; but these objections, of course, hold against concluding that climate is the determining condition. Peckham, for example, explains the larger growth of Milwaukee children over Boston children upon a theory of a greater density of population in the latter city. Dr. Gould and Dr. Baxter, already cited, deal with the problem, in its adult relations for America, and their results would support the view of the influence of climate. The climate has generally been supposed to regulate the time of pubertal acceleration and this, as Key (†[59]) points out, is earlier by a year in Italy and America than in Sweden.

Bowditch ([21]), reviewing Baxter's and Gould's results, concludes that the fact that natives of the Eastern States emigrating in childhood to Western States resemble the natives of the states to which they emigrate, justifies serious inquiry into climatic influences.

The subject of climatic influences as a factor of variation in growth may therefore be taken as yet undetermined, though it hardly seems possible that, at least in some indirect way, it is not important.

Growth in Relation to Susceptibility to Disease.

There seems to be evidence that children are able to resist diseases at certain ages better than at other ages. This conclusion is based upon studies in the death rates of children

(4) P. 173.
(59) P. 79.

and by studies of the prevalence of diseases at different ages of children, undertaken chiefly in Sweden and Denmark. In the report of Dr. E. M. Hartwell, director of physical training in the Boston public schools (1894), is found the conclusion that the period of pubertal change, approximately the five years between the 11th and 16th years, is the period of lowest death rate. The basis for Dr. Hartwell's conclusion rests upon the census returns of Boston for 1875, 1885 and 1890. The rate of deaths per 1000 inhabitants for these three census years together is as follows:

TABLE K.

Showing Children's Death Rate in Boston (Hartwell).

AGES.	F.	M.
0-1	256.24	299.51
1-2	117.58	137.98
2-3	37.01	38.14
3-4	24.80	26.51
4-5	21.55	20.73
5-6	16.44	14.85
6-7	14.38	13.40
7-8	9.62	9.35
8-9	8.11	6.09
9-10	5.11	7.41
10-11	5.23	4.77
11-12	3.23	4.28
12-13	4.30	3.44
13-14	6.17	4.18
14-15	5.83	3.98
15-16	5.89	5.31
16-17	6.57	6.58
17-18	7.94	6.43
18-19	6.32	10.40
19-20	10.48	10.25
20-21	6.95	11.21

The death rate steadily decreases from birth until the 13th year. The decrease from 5 to 12 years is at a slower rate than for the first five years. These figures, of course, do not argue necessarily that all children are more susceptible to attack in the earlier ages, for it must be remembered that the large numbers who die in infancy remove the children more susceptible to sickness. In the percentages for boys, it will be observed that there is a slight rise in the 10th year.

The year of minium death rate is not always the same, Dr. Hartwell points out. It was the 12th year for girls during 1875 and 1885, but the 13th for 1890; in the case of boys, the minimum year was the 13th in 1875, the 14th in 1885, and

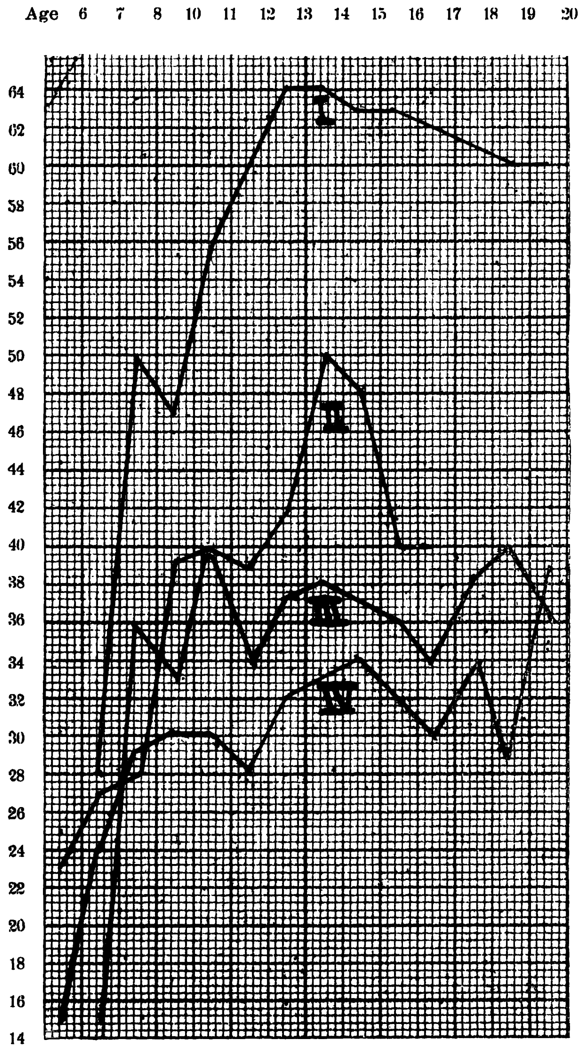
the 15th in 1890. It will be safer, therefore, in considering these figures, to regard the whole pubertal period as one, in a general sense, of strong vitality. The year of strongest vitality for boys is, we see, one year later than that of girls, following, therefore, the periods of development in the sexes. Dr. Hartwell cites Dr. William Farr as calling attention many years ago to the fact that the death rates of England fell to their lowest point in the period 10-15 years of age, during which puberty is established, and rose thereafter. "That the period 10-15 is the half decade in all human life," Dr. Hartwell concludes, "in which the fewest deaths occur to a thousand living, is illustrated in the vital statistics of all civilized countries."

The chief studies bearing upon diseases in the growing ages are those of the Danish (57) and Swedish (58) Commission; the Report of the Committee on Mental and Physical Condition of Children in England (109), Combe of Lausanne, Hertel (52) in Denmark, and Schmidt-Monnard of Halle. The results of the Danish and Swedish Commissions are so similar in many respects that they can conveniently be reviewed together. In Denmark, in 1883, the Danish Commission examined 17,595 boys and 11,646 girls in the higher schools and Volksschulen, 6 to 19 years of age. The information was obtained from teachers, parents, official school physicians and family physicians. The diseases reported are chiefly the distinctly chronic diseases: the acute complaints were excluded. The chief diseases are scrofula, anæmia, nervous complaints, headache, nose-bleed, chronic indigestion, chronic lung and heart complaints, curvature of the spine, and other chronic dieases such as kidney complaints, rheumatism, etc. Shortsightedness is treated separately, and the figures concerning this disease are not included in the present discussion.

The Swedish Commission undertook its work about the same time. The diseases investigated were practically the same. The Swedish Commission, however, dealt with a larger number of pupils in the higher schools and preparatory schools, but excluded data from the Volksschulen. The results are, therefore, not exactly comparable. Diagrams express graphically the prevalence of chronic diseases at different ages, and it is seen at a glance that the form of the curves is singularly alike in both investigations. About 14 to 16 per cent. of the boys at six years of age are afflicted with some chronic disease. The curve rises with abrupt rapidity, until the latter part of the ninth year, when the Swedish curve shows a sudden sinking of 4 per cent., and again rapidly rises in the 11th year. The rate of Danish curve slackens and shows a stationary tendency until the 11th

CHART VII.

Showing per cent of chronic diseases in Sweden and Denmark (adapted from Hertel). I, higher girls' schools of Sweden; II, higher girls' schools of Denmark; III, gymnasia and preparatory schools (boys) of Sweden; IV, approximately comparable schools (to III) of Denmark. Figures on left represent the per cent. of children affected.



year. During the 11th year both curves have reached a crisis. Both fall to their lowest point in the 12th year, the healthiest in the pubertal period. There is then a gradual rise in each, reaching a second summit, in Sweden, in the 14th year and in Denmark in the 15th year, and both sink in the 17th year, the close of the period of rapid growth, to rise abruptly in the 18th and 19th years. Hertel's own investigation ([52]), undertaken in 1881 upon 3,141 boys and 1,211 girls in the higher schools of Copenhagen, practically agrees in form with the foregoing in essential fluctuations.

The disease curves for girls show the same agreement in form in the two investigations, though, as in the case of boys, disease is proportionately more prevalent in Sweden than in Denmark. At 6 years, from 22 to 25 per cent. of the girls are afflicted with chronic complaints, and the curve rises gradually until the 14th year and then sinks, rapidly and considerably in Denmark, and but slightly in Sweden. Two fluctuations are to be observed, one in the 9th year in Denmark, and from the middle of the 9th to the 10th in Sweden; a second, more distinct in Sweden from the 11th to the 12th year. It would seem at these periods there is a slight improvement in health of the girls.

Combe of Lausanne gives data more upon the individual plan. His observations are upon about 2,000 school children, covering a period of 6 years. Combe's figures give data only from the 9th to the 15th years. His data include some of the infectious as well as chronic diseases, and, therefore, are not comparable to those of the Danish and Swedish Commissions. In the 9th year 64 per cent. of the boys are afflicted, but the curve abruptly sinks to 29 per cent. in the 14th year, just before the year of most rapid growth in height (43 in 10th year, 42 in 11th, 40 in 12th, 33 in 13th); from 29 per cent. in the 14th year the disease curve rises to 34 per cent. in the 15th. With girls there is a percentage of 88 per cent. in the 9th year; it falls to 75 per cent. in the 10th and 60 per cent. in 11th, but with increase in rapidity of growth, rises to 66 per cent. in 12th and 68 per cent. in 13th; then sinks to 61 per cent. in 14th, and 39 per cent. in 15th year.

Schmidt-Monnard's study upon several thousand pupils in the higher and middle schools of Halle, is approached largely from the assumption that the schools are responsible for sickness, and his effort is chiefly to trace this causal relation. However, his data show whether the causes be in the schools wholly or partly in organic conditions of growth, that there is from 5 to 10 per cent. less sickness among boys than girls at all ages; that the amount of sickness varies with kind of schools, social condition of pupils, and grade (or age). Averaging his results he finds that the sickness curve steadily

rises until the 13th or 14th year in both sexes, and then falls from 30 to about 18 per cent. with boys, and from 30 to 40 per cent. in the case of girls, to 27 per cent. His data do not give information beyond the 15th year. Among the conclusions of the author are the following: Acute diseases occur principally in the primary school years, and in general are more frequent and persistent in children of unfavorable nutritional conditions than among the favored classes—among Bürger school children less than among the Volksschulen; chronic diseases increase during the school year and are especially induced in schools having an afternoon session, or children burdened by outside duties such as music, housework, etc.; in the 13th or 14th year there is nominally a decrease in the percentage of disease.

The Report of the British Committee on Mental and Physical Condition of Children ([109]), embracing the results of Dr. Francis Warner's investigation and covering the data of 100,000 English children, is not classified in form and matter in a way that permits comparison with the foregoing studies.

This report, together with Dr. Francis Warner's publications, furnishes information and suggestions which no one responsible for the care of children can afford to be without. The report deals chiefly with: (1) defects of development of the body and its parts in size, form, or proportion of parts; (2) certain abnormal actions, movements and balances due to nervous abnormalities or disturbances; (3) low nutrition; (4) mental dullness. All of these publications are readily available in English. The report is published by the Committee, Parker Museum, Margaret street, London, W. (1895). Dr. Warner's original report of 50,000 children (which comprises half the present report) is reprinted in the Report of the Commissioner of Education (U. S.), Vol. II, for the year 1890-91.

Growth and Resistance to Disease: There has been an attempt to connect the periods of rapid growth with those of power to resist disease. The figures upon death rates, as Dr. Hartwell concludes, certainly point to this conclusion. Dr. Hartwell in support of his position gives the following table, comparing the rate of growth in both height and weight with what he terms "specific life intensity;" by this he means the ratio of the number dying at a given age to the number living at that age. When this ratio is high, a high power of resistance to disease is indicated, and *vice versa.*

Axel Key of the Swedish Commission agrees with Dr. Hartwell in linking better resistance to disease with accelerated growth, and the susceptibility to disease with the periods of slow growth. "The curve of disease (in boys)," he ob-

CHART VI.

Comparing specific life intensity with rate of growth in height and weight for Boston children. Curves I (boys) and II (girls) show specific life intensity (taken from Table L); curves III and IV and curves V and VI represent respectively the percentage annual increases in weight and height as given in Tables G and C. Continuous line represents boys, and dotted line girls. Figures on left apply to curves I and II; figures on right to III, IV, V and VI.

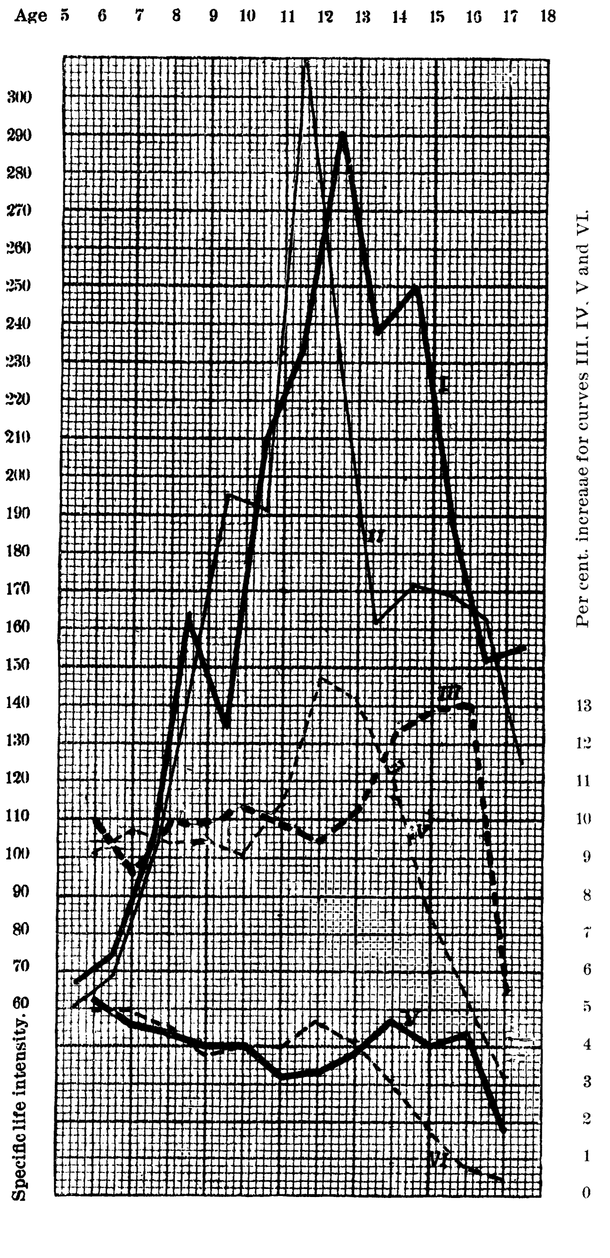


TABLE L.

Showing Specific Life Intensity of Boston Children at Different Ages (Hartwell).

(The figures in heavy-faced type indicate the pubertal years.)

AGE.	Per Cent. Increase. Height.		Specific Life Intensity.		Per Cent. Increase. Weight.	
	Girls.	Boys.	Girls.	Boys.	Girls.	Boys.
5—6	4.00	5.20	60.08	67.3	8.88	10.24
6—7	4.08	4.58	69.5	74.5	9.69	8.78
7—8	4.58	4.38	103.8	106.8	8.83	9.86
8—9	3.72	4.03	123.2	164.0	10.68	9.79
9—10	**3.98**	4.04	**195.4**	134.8	9.26	10.40
10—11	**4.06**	3.12	**191.2**	**209.3**	**10.24**	7.43
11—12	**4.56**	**3.39**	**309.0**	**233.2**	**13.78**	**9.74**
12—13	**4.08**	**3.78**	**232.0**	**290.1**	**13.23**	**10.31**
13—14	3.11	**4.68**	162.0	**238.7**	**10.94**	**11.66**
14—15	1.90	**4.01**	171.3	**250.1**	7.83	**13.02**
15—16	.77	**4.36**	169.3	188.1	5.61	**12.96**
16—17	.51	1.75	152.0	151.9	3.14	5.23
17—18	....	.77	125.6	155.3	...	3.97

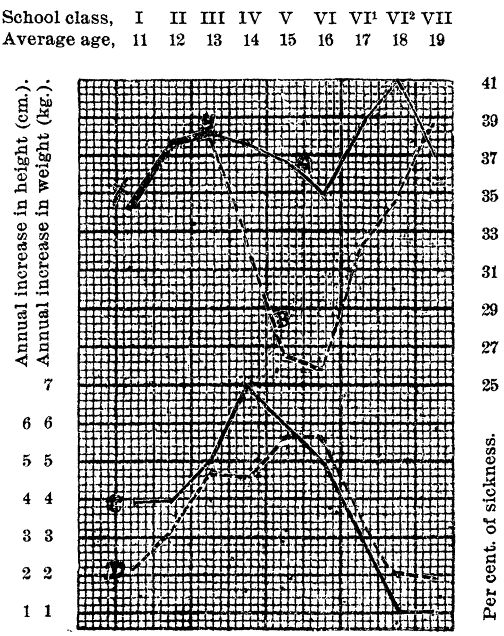
serves, "reaches its first summit directly before, or, more correctly, at the beginning of the pubertal development. But as soon as this development sets in forcibly, the curve sinks year by year, so long as that accelerated growth continues. The curve is lowest the two last years of the pubertal period, just when the increase in weight is greatest. Directly at the conclusion of the pubertal period, when the yearly increases in height and weight hastily decrease, the curve of disease, on the other hand, jumps to its second summit, which it reaches in the 18th or 19th year (†[58]). The year of strongest health is, therefore, the 17th. For no year is the height of the curve of disease so great as for the 18th, and next to it is the 13th. On the other hand, regarding the period of slow growth from the 8th to the 12th year, Key con-

([58]) P. 250.

cludes, "All facts point unquestionably to the conclusion that the period of slow development preceding puberty is a period during which the power of resisting injurious external influences is weak, and the percentage of sickness increases, particularly in the years immediately prior to the pubertal

CHART VIII.

Percentage of chronic disease in Swedish boys' schools in comparison with rate of growth (after Key). Curve x-y, sickness in Volks classes; curve A, sickness in Latin classes; curve B, sickness in Real classes; curve C, annual increase in weight (kilograms); curve D, annual increase in height (centimeters). Figures on right represent percentage of pupils affected by disease.



development." In the case of girls, Key finds that the relation of rapid growth and decrease of sickness does not appear so sharply defined as in the case of boys. He says, "With the development of girls throughout, the curve of sickness reaches its first summit in the second pubertal year (the 13th), which is the year of accelerated increase in weight, and sinks thereafter very little, and rises not directly after the conclusion of pubertal growth, but in reality two years later (in the 18th). We see, therefore, that the last year of puberty must be recognized as the weaker in resistance than the one which directly follows the close of the period."

Hertel ([53]) in Denmark, in his discussion of his own investigation and that of the Danish Commission, seeks to find the causes of fluctuations of the percentage of disease in various years in local conditions of the school and the home, rather than in any organic relation to the growth processes. He says, however, of the period of three or four years prior to the pubertal change, "It would appear that this change is preceded by a short period of greater delicacy than usual, with greater susceptibility to unfavorable external influences" (†[52]). "The maximum percentage of disease," he says, "is reached in the 12th or 13th year, directly at the threshold of the pubertal period. The strong physical development during this period is not able to lessen materially the percentage of sickness, and the amount of sickness in these remains high in the case of both boys and girls" (†[53]). Dr. Hertel apparently agrees with Key of Sweden that the impulses of growth in the pubertal period tend to inhibit diseases, but the other unfavorable conditions, both external and internal, tend, on the other hand, to increase sickness. Thus he concludes, "Indeed, these unfavorable influences must be influential after the period of puberty, since immediately after this period, as soon as the accelerated period of growth and with it the greater power of resistance to disease, ends, sickness increases abruptly and very considerably" ([53]). His conclusion is based upon the following tables from the report of the Danish Commission:

TABLE M.

Showing Percentages of Chronic Diseases in Danish Boys' Schools (Hertel).

	No.	Age.													
		6	7	8	9	10	11	12	13	14	15	16	17	18	19
I. Gymnasia,	2,099	—	—	—	—	—	26	52	33	34	32	30	34	29	45
Real Schools,	4,343	15	24	29	30	30	28	29	30	29	22	26	31	25	—
Bürger Schools,	2,313	16	21	23	28	31	29	27	25	24	22	10	38	—	33
II. Volksschulen.															
City { Tuition,	3,746	21	24	26	26	29	28	31	30	30	—	—	—	—	—
City { Free,	2,047	32	32	34	33	37	37	37	33	26	—	—	—	—	—
Village { Bauer,	1,446	13	13	28	27	30	27	30	29	28	—	—	—	—	—
Village { Arbeit,	938	—	28	33	30	28	30	35	25	—	—	—	—	—	—

(52) P. 32. (53) Pp. 181-2.

TABLE N.

Showing Percentages of Chronic Diseases in Danish Girls' Schools (Hertel).

	No.	Age. 6	7	8	9	10	11	12	13	14	15	16
Higher Schools,	3,858	23	27	28	39	40	39	42	50	48	40	40
Volksschulen. City Tuition,	3,023	24	36	33	38	41	44	45	57	52	--	—
City Free,	2,018	31	37	40	42	51	48	60	55	53	—	—
Village Bauer,	1,379	21	24	29	33	44	36	52	46	50	—	—
Village Arbeit,	872	29	39	33	36	44	53	49	57	56	—	—

Combe of Lausanne reaches conclusions diametrically opposed to those of Key relative to the relation of growth and disease. He says (†[25]): "Sickness increases with growth; in other words, the more a child grows, just so much the more is it inclined to disease. The periods of most accelerated growth represent, therefore, the periods during which the organism possesses the least power of resistance to disease." He offers the following table, compiled from data of 2,000 school children of Lausanne, during a period of six successive years.

TABLE O.

Showing Percentage of Sickness in Schools of Lusanne by Years (Combe).

Age.	Boys. Per cent. of Sickness.	Boys. Annual Increases in Height in cm.	Girls. Per cent. of Sickness.	Girls. Annual Increases in Height in cm.
8— 9	64	4.8	88	4.9
9—10	43	4.7	75	4.9
10—11	42	4.4	60	4.9
11—12	40	4.1	66	5.4
12—13	33	4.4	68	5.5
13—14	29	4.6	61	5.1
14—15	34	7.0	39	5.0

([25]) P. 581.

It must be remembered, however, that Combe's investigation is not comparable with those in Denmark and Sweden, for the reason that Combe includes a few of the infectious diseases; and further, he compares sickness with acceleration in height, while Key's conclusions are based upon comparisons with acceleration in weight which reach a maximum a year or so later. Combe, however, under some misapprehension, cites both Hertel and Key as supporting his view.

With regard to the period from 7 to 11 years in girls and 7 to 13 years in boys, Combe concludes that sickness is greater among the former than among the latter, and always increases directly in proportion to the rate of growth.

The studies, which have been reviewed with the exception of those of Combe, have dealt almost exclusively with the chronic diseases, ignoring the acute complaints. Another important field of data, therefore, is that of the normal epochs for the appearance of the usual children's diseases. Clouston's "Neuroses of Development" is a valuable handbook for the teacher, dealing with certain developmental diseases; chorea, for example, which is a disease of serious importance in pedagogy, occurs, according to Clouston, chiefly between the ages of 6 and 15 years: seventy-five per cent. of the cases occur during this period, and only fourteen per cent. during the period of adolescence. The publications of Crichton-Browne are also most helpful and important.

In the field of strictly medical literature, there is a mass of scattered facts bearing more or less directly upon the problem at issue. Dr. Boulton ([17]) says: "Arrest of growth or loss of weight precedes so many diseases that it may be looked upon as a danger signal, and if the 'caution' is noticed before the disease point is reached, catastrophe may frequently be prevented, and so, childhood may be worked on a kind of block system."

Dr. Moulton ([73]) offers several cases of insanity showing a direct relation between gain and loss in weight with improved or impaired mental condition of the patients. When patients improved, weight rose, and *vice versa*.

Dr. Evetzky ([33]) finds among infants that disturbances of nutrition incident to dentition are indicated by a decided diminution in the normal rate of growth.

Dr. H. P. Bowditch ([21]) says, "It has been frequently remarked that a period of rapid growth is apt to follow certain fevers, and it would, therefore, be very interesting to inquire whether this accelerated growth after the disease is anything more than a compensation for loss during the disease, and whether in this period of rapid growth the height and weight preserve their normal relation to each other." Dr. Bowditch offers an interesting chart in the same article tracing the variations in weight of an infant girl from September to April. The periods of slight sicknesses are coincident with loss in weight, and *vice versa*. The curve, however, is singularly like those due to seasonal changes, according to Malling-Hansen's law.

Relation of Size to Precocity and Dullness.

Dr. Townsend Porter ([79]) from his study upon St. Louis school children concludes that, on the average, precocious

children are heavier and taller than their duller fellows of the same age. Dr. Porter's basis for this conclusion may be briefly summarized as follows: He tabulated the heights and weights of 34,500 boys and girls from the kindergarten through the high school. He then classified the pupils of the same age in tables, showing the school grades to which they belonged. Boys of 9 years, for example, are found to be distributed from the first to the fifth grades inclusive. He then calculated, by Galton's system, the mean weights for each age irrespective of grade, and also the mean weight of pupils of each age for each grade in which they are found. His figures very distinctly show, taking a given age, that the pupils of that age found in the higher grades are heavier and taller than the pupils of the same age found in the lower grades. For example, the mean weight of boys of 11 years is 68.47 pounds. Boys of this age found in the first grade weigh 63.5 pounds; in the second grade, 65.45; third, 68.12; fourth, 69.24; fifth, 71.29; sixth, 73.34 pounds.

Table P gives Porter's results, showing the distribution of girls and boys of the same age throughout the grades, according to weight. The figures for girls are in heavy-faced type, those for boys in light-faced.

Porter does not give complete tables with regard to height, but the following figures for boys of 10 years and girls of 12 years he considers sufficient to indicate the same law with regard to height:

	Mean Height in Centimeters.					
	Grade I.	II.	III.	IV.	V.	VI.
Boys, 10 years,	126.5	129.39	130.29	131.22		
Girls, 12 years,		136.06	139.04	140.08	141.96	141.9

Dr. Porter also shows a relation in the same manner between the chest at forced expiration and width of head to precocity.

In verification of his results, Dr. Porter cites similar but very much smaller investigations in Russia, one by Dr. Gratsianoff and another by Dr. Sack. Both found that successful pupils are larger and have larger chests than unsuccessful, but Sack disagrees with Gratsianoff that the rate of growth in the successful is quicker.

Dr. Franz Boas (11) criticises, in some degree, Dr. Porter's results, contending that what Dr. Porter has shown is that "mental and physical growths are correlated; not that mental development depends upon physical growth." Dr. Boas points out that naturally the sickly of a given age will be retarded in their advancement.

Three other attempts have been made to find a relation,

TABLE P.

Showing Relation of Precocity to Weight as Indicated by Distribution of Heavy and Light Children of the same Age in the Different Grades of St. Louis Schools (after Porter).

Age at nearest Birth-day.	Mean Weight Lbs.	GRADE.									
		Kind.	I	II	III	IV	V	VI	VII	VIII	HighSch.
6	43.74	43.58	45.29								
	41.84	**41.65**	**45.08**								
7	47.73	45.58	48.48	52.00							
	45.84	**43.87**	**46.76**	**49.88**							
8	52.58	47.80	51.79	54.43	57.00						
	50.35	**46.50**	**49.60**	**52.10**	**53.17**						
9	57.75		55.87	57.64	59.66	61.75					
	55.17		**52.57**	**55.44**	**57.18**	**60.00**					
10	62.48		60.19	61.14	64.00	64.91					
	60.46		**57.00**	**59.59**	**61.15**	**61.64**					
11	68.47		63.50	65.45	68.12	69.24	71.29	73.34			
	65.64		**66.34**	**62.95**	**65.50**	**66.77**	**68.12**				
12	73.61		70.00	69.50	72.17	73.86	74.69	77.29	76.50		
	73.23		**71.75**	**69.80**	**71.50**	**72.74**	**75.13**	**75.92**	**78.50**		
13	79.85			74.25	75.95	78.43	80.90	82.17	83.50	82.00	
	83.73			**79.50**	**76.50**	**81.92**	**82.78**	**86.95**	**87.63**	**88.50**	
14	88.08				81.00	84.00	87.83	87.20	93.63	97.50	86.50
	93.94				**90.50**	**87.17**	**92.67**	**94.64**	**96.15**	**99.00**	**103.12**
15	100.20					89.00	95.33	99.17	105.50	105.17	105.08
	103.20					**98.50**	**100.96**	**99.83**	**104.00**	**104.58**	**105.15**
16	114.17							114.50	104.00	114.00	123.00
	110.06							**108.12**	**107.38**	**110.29**	**113.57**
17											
	115.69									**111.00**	**116.00**

either positive or negative, between prococity and physical growth: Dr. J. Allen Gilbert's studies upon Iowa and New Haven children, and the investigation of Toronto children by Dr. Boas. None of these use the test of precocity adopted by Porter, advancement in the grades, but take, as the test, the teacher's off-hand estimate or impression of quick intelligence.

Dr. Gilbert classifies the heights and weights according to the teacher's estimate of "bright," "average" and "dull." The number of children are about 100 for each year of age, 6 to 19. Upon this basis of test, there is no manifest relation. In weight, the bright children are slightly lighter on the whole and the dull children are heavier, most distinctly from 10 to 14 years. In height, about the same might be said. Dr. Gilbert feels justified in concluding, "The curves cross and recross in such a way as to show no constant relation between physical development and mental ability. If anything could be stated, it would be that the heavier and taller children are the duller, but here also the curves cross too frequently to justify any definite statement in regard to any relation so existing."

Dr. West with Dr. A. F. Chamberlain assisted Dr. Boas, in 1892, in making a study of children in the Toronto schools. The complete report is not yet published, but Dr. West has made a preliminary statement of results ([103]). The stature and weight were taken and grouped with reference to mental power, according to the teacher's impression, as "good," "average," "poor." Dr. West summarizes: "We find that, as a general rule, the 'poor' children are more fully developed than the 'good' children, though in each series of measurements, there are one or two cases when the 'good' children show a higher average than the 'poor.' These cases are generally near the latter end of the series." Dr. West, in discussing the disagreement of Toronto results and those of St. Louis, contends that an error pervades Dr. Porter's results, since a number of pupils enter school at a late age and would, therefore, be incorrectly counted as "dull" pupils; further, that Dr. Porter's system of reckoning age according to the nearest birthday introduces a misinterpretation of results.

The stature of the Fellows of the Royal Society is slightly above that of the professional classes of England (†[37]), and Roberts' tables show that the professional classes of England are distinctly taller than any other class. Roberts' tables also show that, compared with the general population, lunatics are shorter by 1.96 inches and lighter by 10.3 pounds. Clouston* finds that the 200 pupils of the National Institution at Larbert, England, are much under the normal average, both in weight and height. Dr. G. E. Dawson finds that in American institutions for defectives the children are distinctly undersized.

Dr. G. G. Tarbell of the Boston Home for Feeble-Minded

([37]) P. 21.
* "Neuroses of Development."

measured and weighed the inmates, ranging in age from 6 to 19 years, and constructed a chart, which by comparison with that of Dr. Bowditch indicates that the idiotic and feeble-minded children in that school are about two inches shorter and nine pounds lighter than normal children of the same age; that the relative rate of growth of the two sexes corresponds in principle with that of normal children and is subject to the same variations at the age of puberty; that the period of puberty is about two years later in idiots than in normal children.

A report by Dr. G. E. Shuttleworth of England confirms Dr. Tarbell's statements. The former gives a comparison of the heights and weights of 1,209 idiots and imbeciles in English asylums, showing a distinct inferiority as compared with heights and weights of normal children of corresponding ages. From data of 300 idiotic and imbecile children collected by Dr. Shuttleworth, he found that they were shorter than normal children by one inch at 5 years, two inches at 10 years, three inches at 15 years and 20 years. In weight, the defectives were lighter by four and one-half pounds at 8 years, at 10 years by six pounds, at 15 years by eight pounds, and at 20 years by twenty-three pounds. However, there are, as Dr. Shuttleworth points out, many factors that must be taken into account in comparison. They are more susceptible to disease than normal children, the mortality among them being probably nine times greater. Many are undoubtedly small at birth, and not a few have been prematurely born. The mortality curve follows Hartwell's law, being 50 per cent. for ages 5 to 10, 33 per cent. for ages 10 to 15, and 45 per cent. for ages 15 to 20.

General Principles of Growth.

Since Quetelet, a half a century ago, gave an impetus to the study of the phenomena of growth in the human body, much data have been gathered, but as yet few, if any, conclusive principles have been clearly established. A few tendencies to formulate laws, however, should be mentioned.

Growth by Rhythms. Probably the most elaborate effort to present wide general laws has been made by R. Malling-Hansen. It will be remembered that the autumn season is the period of maximal rate in weight and the minimal period for height; that spring reverses the relation and that winter is a period of moderate increase for both. In the daily rhythm* the same relation was observed, that what the body gained in height by night it lost in

* The average daily loss for the 72 boys was .64 kilograms.

weight, and gain in weight by day was accompanied by an actual loss in height. These facts, harmonizing with other phenomena of growth, seem to justify the conclusion of Malling-Hansen that the periods of most rapid growth in height are, to say the least, periods of rest in growth in weight, and *vice versa*. A significant fact is that the height periods begin and end about fifteen days before the weight periods. The author cautiously suggests as a possible hypothesis that the circumstances "that height increases most rapidly when weight decreases, and also the fact that the phases of growth somewhat precede those of weight, appear to signify that the increase in height has been directly at the expense of weight increases. It has the appearance that the growth in height at the conclusion of its maximal period (which is just when the period of increase in weight begins) had consumed its food that had been stored up in the body; and as if, therefore, in the course of the autumn (which is the period of maximal growth in weight) the means for beginning a new height growth were then cultivated. On the other hand, however, the fact occurs that the maximal period of height growth does not follow directly the increase in weight (*i. e.*, the winter period of slower growth in both height and weight intervenes). It would seem, on a little reflection, that growth in height and growth in weight must be very different processes." Malling-Hansen gives a very plausible explanation of these processes. He argues that since during the autumn maximal growth in weight the vertical increase in height is slight, that, therefore, some other explanation must be sought for this weight increase. He thinks the length of the period, four and one-half months, precludes the explanation that the body is merely absorbing water. Aside from the possible storing up of nourishment for later height growth, he concludes that the growth in weight is due to lateral extension of the body, a growth in thickness therefore. During the middle period, from December to April, when the body is growing both in weight and in height, the increments of the latter must be estimated as a factor; but how much goes for the vertical dimensions and how much for the lateral we are, of course, unable to determine. In the spring and summer, when the body is increasing in height most rapidly, it actually loses in weight, and we must conclude that during this period the process of decay of cell structures exceeds the constructive process. A loss in the amount of water may possibly be reckoned as a factor. Malling-Hansen, however, feels justified in laying down the following principle of growth: "In the maximal period of lengthening, the thickening of the body is at its minimum, and *vice versa*; the thickening has its

maximum in the time of minimal lengthening." He measured also a number of trees for a number of months, the tables of measurements of which he gives, and found the same law sustained. In early spring the trees grew in height, and later rested in height while they thickened out in circumference.

A very scholarly contribution to the principle of growth by rhythms has been made by Dr. Winifred S. Hall from study of Haverford College students and grammar school boys. He develops the same law of separate rhythms for height and weight in the larger periods before and during pubescence that Malling-Hansen uses for the seasons. He concludes: "When the vertical dimensions of the human body are undergoing acceleration of their rate of growth, the horizontal dimensions undergo a retardation of their rate of growth, and conversely." As ground for this important conclusion, Dr. Hall cites the following facts from his data: "If the percentage series of total girths be represented by a curve, the rate of growth of the ninth year will be seen to continue through the tenth, thus surpassing the height. From the 11th to the 13th year the increase is less and less rapid, and is surpassed by heights; from 13th to 14th, more rapid, and surpasses height; from 14th to 15th, the girths are again surpassed by heights; but during the 16th year the girths gain a permanent and ever-increasing ascendency. That these curves cross each other four times between the 10th and 16th years is an exceedingly interesting fact. It may be considered as one of the most important laws of growth. A reasonable interpretation seems to be that the body widens and then takes an upward shoot, then widens out preparatory to another upward shoot. To make such a phenomenon possible it is necessary that the curves of height should show at least one period of rapid increase. The curve of heights shows (in his own data for males) two such periods, 12 to 13 and 14 to 15; Bowditch found two, 10 to 11 and 13 to 14; Pagliani, one, 13 to 17; Key, two, 12 to 13 and 15 to 16; Kotelmann, 12 to 13 and 14 to 15." According to Dr. Hall, the growth in height is due "largely to increase in the length of the long bones. If we can compare the girth of bones with their length, we shall find the same thing true of bone growth as of general body growth. The increase from 9 to 12 is unchanged, but when the bones begin to increase rapidly in their vertical dimensions, from 12 to 13, we find the increase in lateral dimensions essentially retarded, and when the vertical dimension undergoes its second retardation, between 13 and 14, the joint girths make an increase which more than makes up for their previous retardation." Dr. Hall makes this conclusion general.

Peckham (†[76]) concludes: "The growth of the body and of the lower extremities takes place in such a way that the length of the body of the girl is less than that of the body of a boy until the 10th year, and thereafter greater until the 16th year. From 15 to 18 years the bodies of girls grow only two inches and the bodies of boys over four inches. For the lower extremities, at nine years of age those of the girl are longer, at 11 shorter, and from 12 to 14 again longer. At 14 tne lower extremities of the girls almost cease growing, while those of the boys increase by four inches between the ages of 14 and 19 years.

This rhythm of alternating activity and rest in growth finds at least its analogy in cell multiplications and growth. The means of increase in number among cells of an organism and among the lowest orders of living matter is by division. The parent cell swells in size until a certain point is reached, and then, by a more or less complex process, divides into two parts. A period of rest then generally ensues, and somewhat later these two cells begin to swell and repeat the process. Whether this principle of activity and rest here exemplified has a direct relation in the growth of the complex higher organisms is, of course, a matter of mere speculation. Minot (†[69]) points out that probably changes in one direction are counterbalanced by changes in an opposite direction, thus maintaining, it would seem, a balance on the average.

Growth by Parts. It has been a popular notion of growth that the process is continuous throughout the body; that if, for example, a cross-section of the various parts and organs were taken in equal divisions of time, the amount of growth in each part or organ would be found in the same proportions. The studies in physiology and anthropometry during the past half century or so have turned the drift of conviction toward the other extreme, and the problems of the present are those of "retarded" growths and "accelerated" growths, not only of the organism as a whole, but also in specific parts. While each part may be assumed to have some sort of relation to other parts, nevertheless the modern tendency is to discover the growths of the parts individually as a basis for investigation of the relations and dependencies of one form of growth, or the growth of one part upon the others. From the physiological standpoint, probably the most complete presentation of the data relative to this subject, collected and contributed, has been made by Vierordt.†

([76]) P. 35. See also pp. 32-33.
([69]) P. 195.
†Gerharudt's *Handbuch der Kinderkrankheiten*, *erster Band*, *erster*

Further, physiologists distinguish between a growth by increase in the number of cells and a growth consequent of mere swelling of cells already existent. The unstriped muscles, for example, actually increase in number of cells; but the number of cells in the brain, on the other hand, does not increase after birth—they simply swell in size. A third kind of growth is to be distinguished in the replacement of cells that have decayed. Still another complication of the growth problem arises in the increase in fat. This is not generally termed growth. After twenty-five years of age there is generally an increase in fat, materially adding to weight, and thus making it difficult to determine the exact amount of real growth. At best, therefore, growth in stature and weight is merely significant perhaps of activity of growth processes taking place in several parts of the body at once. To trace these growths in detail would far exceed the limits of this study, and would lead deeply into anatomical and physiological problems. That growth is relative in the different organs is neatly illustrated in a table by Bischoff, quoted by Donaldson (†[29]), showing the percentages of weight of different parts or systems of the human body at birth, at sixteen years and at maturity. Commenting upon this table Donaldson says: "On comparing the proportion of the different systems in the new born with the adult, the following relations are worthy of remark: The percentage of the skeleton, fat and skin taken together, is but slightly smaller in the new born. The percentage of the viscera in the new born is nearly twice that of the central system, and more than eight times that found in the adult, whereas the proportional weight of the muscles shows only a trifle more than one-half its adult value. The purely constructional parts of the body, the skeleton, fat and skin, which are formed predominantly of connective tissue, have therefore not varied their proportions during growth; while the nutritive and controlling system, that is, the abdominal and thoracic viscera and the brain, have undergone a relative diminution, having in a most remarkable way been outgrown by the muscular system."

From birth to complete maturity the body increases in height 3.37 fold, and in volume 20.66 fold (†[29]). Roberts (†[82]) gives a succinct résumé of relative growths of different parts of the body. The

---

Abtheilung, 1881, contains a résumé by Vierordt of the subject to date, 288 pages with abundant tables. In the same volume is also a valuable collection of data upon the anatomy of children by Henke. Vierordt's *Physiologie des Menschen* (1877) and his *Hnatomische Physiologische* and *Physikalische Daten und Tabellen* contain a mass of collected data of immense value.

([29]) P. 67. ([29]) P. 50. ([82]) P. 108 *et seq.*

head doubles in height, and the development of all horizontal measurements of the head is still less than that of its heights. It is not till about the sixth or seventh year that the neck commences to grow, and after adolescence averages about two inches. The diameter of the neck increases rapidly at the pubertal age. The height of the trunk of the body trebles from birth to maturity. The diameters of the trunk at the shoulders, chest and hips grow proportionally with the height; but the diameter of the chest, front to back, doubles toward the age of puberty. The change in relative proportions is shown by the fact that while at birth the point which divides the total height into two equal parts is a little above the navel, this point gradually sinks until in adult man it is about half an inch below the pubes, and in woman a little above. The lower extremities are about five times their length at birth. The arms are about four times the birth length. Probably one of the most careful series of measurements in this field is that of Dr. Landsberger of Posen. Dr. Landsberger measured in 1880, 104 children, and continued these measurements annually for seven years.

Vierordt (†[93]) gives the following table of lengths from computation of various measurements, showing the growth of various parts of the body, the size at birth as unity. Thus, taking the first line to illustrate, the child's head grows in length during the first 21 months of life half its length; at the end of seven and one-eighth years, 91.7 per cent. and at maturity the head is twice as long as at birth.

	Birth.	End of 21st Month.	Seven one-eighth Years.	Adult.
Length of head,	100	150	191.7	200
Upper part of head,	100	114	150	157
Length of face,	100	200	250	260
From chin to upper end of breastbone,	100	500	700	900
Breastbone,	100	186	300	314
Abdomen,	100	160	240	260
Leg,	100	200	455	472
Height of foot,	100	150	300	450
Upper arm,	100	183	328	350
Forearm,	100	182	322	350

Theory of Compensation. In the suggestion of Dr. W. S. Hall and Malling Hansen (see pp. 299-301), that growth in height

([93]) P. 272.

during the resting period of growth in weight is at the expense of the latter, we have the suggestion of an important theory of the process of development which will appear in the treatment of later forms of growth, more especially in the psychic field. It might aptly be called the theory of compensation, and perhaps may be regarded as the antithesis of growth by parts. In the lower metazoic forms of life we find a colony of cells or group of cells, each an individual, as it were, capable to all appearance of practically all the functions of the whole. A bit of begonia leaf will reproduce the entire plant; if we section a centipede into parts, each part to a limited extent is capable of doing business on its own responsibility. Weismann's great attack upon the doctrine of transmission of acquired characters depends upon the contention that the reproductive cells are absolutely independent of all other parts of the body (except in conditions of nutrition), thus preventing peculiarities acquired during the life of a parent to be transmitted to offspring. In the human body the digestive system to a great extent is an independent organism supplied with its own nervous system and capable, up to a certain limit, of performing its duties without the interference of other parts of the body. Flechsig† has shown that in the development of the nervous system there is a growth by parts. The different strands of fibres in the spinal cord, and the fibres leading to different areas of the brain, commence their growth at certain specific periods, and grow in seeming independence of one another. We have here the theory of parts. Now, in how far is this true as a general principle of growth? In how far may we regard growth as a process dependent upon processes and functions contained within the part concerned? In how far does the growth of one part depend upon functions in other parts? We do know that, past a certain limit, the digestive system is essentially dependent upon other systems; that defect in blood supply affects every part of the organism. But in how far does the growth of the legs affect growth of lung capacity, the development of the brain centres of hearing affect the brain centres of sight, favorably or unfavorably; or, to go further, in what way does the exercise of the physiological factors concerned in memory affect those concerned in what we call reasoning? These are far-reaching questions, and as yet there is no answer whatever to them. On the one hand we have inferences that to a certain extent, and probably to a greater extent in some parts than in others, these parts are independent organisms, governing their growth and

†*Die Leitungsbahnen im Gehirn und Rückenmark.* Leipzig, 1876. Also *Gehirn und Seele.* Leipzig, 1896.

exercise by forces resident within themselves as individuals. On the other hand we have inferences of the principle of compensation by which each part is dependent upon other parts, at least for certain services, and to some extent governing other parts. Does growth in height, for example, borrow the food supply which the forces of weight have stored up? Is this loan compensated to weight in some way, so that without an advance in height there is no extension in weight or an impairment of it? Existence and growth by parts and by compensation are correlative and opposing theories of significance, not only to biology, but to education at every step.

The determination of these principles, growth by parts and compensation and their relative scopes of activity, underlie the crucial problems of growth and education.

Persistence of Growth. There is a tendency to establish as a principle that each individual organism strives to reach some size particular to that individual. If disease in any way interferes with this progress in its natural course, the organism later seems to make redoubled growth to make up for the accidental loss. Pagliani† points out this fact in the surprising recovery of children placed under favorable nutritional conditions after a period of poverty. It is a general fact of medical observation that sickness in growing children is accompanied by a loss in weight and retardation in height, and that, seemingly in consequence, convalescenee is followed by very rapid growth, apparently indicating that the organism is striving to make up for the loss. Minot (†[70]) has shown this in his experiments with Guinea pigs, and he concludes from a significant array of facts that "each individual appears to be striving to reach a particular size. The fact, which I have thus expressed, is that if an individual grows for a period excessively fast, there immediately follows a period of slower growth, and *vice versa*; those that remain behind for a time, if they remain in good health, make up the loss (at least in great part if not always completely) soon after. Indeed, to permanently dwarf a Guinea pig requires an astonishingly prolonged interference; thus a young pig may lose one-third of its weight from a severe intestinal catarrh and yet make it up subsequently. The number of similar observations is so great that we might assert safely that a pretty severe and prolonged illness will not affect very much the ultimate size. It is probable that the same is true of man, and that, therefore, the usual and even the severer illnesses of childhood and youth do not greatly affect the ultimate size of the adult." A

†So Sviluppo umano.
([70]) P. 134.

forcible illustration of this struggle, seemingly of internal and perhaps hereditary forces, to obtain for the individual a specific size, is offered by Camerer ([23]), who found, as stated, that however different the diet by which infants during the first year of life were nourished, all of approximately the same weight at birth reached practically the same weight at the end of the first year; the curves, however, show significant fluctuations at times during the year, suggestive of a struggle of the internal forces of the organism to combat the unfavorable external influences.

Accelerated Growth in Large and Small Children. The contribution made by Dr. Bowditch ([20]) in his application of the Galton method of percentile grades† to the heights and weights of Boston children is what seems to show that large children make their pubertal rapid growth at an earlier age than small ones (of the same age). The age at which the maximum yearly growth in height and weight is reached is distinctly earlier in the percentile grades (for the same age) representing the children who are taller and heavier. The range for the beginning of the prepubertal acceleration according to size is from 12 to 14 years in girls and from 14 to 16 in boys. Large boys grow at an accelerated rate longer, but not necessarily more rapidly than small boys; this phenomenon Bowditch does not observe in his data for girls. The law does not apply apparently to children under ten years. But the theory of large and small children rests upon the assumption that a child, who in a certain degree is larger or smaller than the mean of his age, maintains throughout this growth this degree of deviation, that the small child of one year of age is the small child of the next. Dr. Boas in two articles* has attacked this theory, and his argument seems convincing that such an assumption is untenable; for the small child of one age may be the large child of the next age. This criticism undermines the value of many of the conclusions drawn from Galton's percentile method of calculation.

Co-education of the Sexes. Growth, so far as height and weight are concerned, seems without sex conditions up to the period of prepubertal increase. Girls and boys grow practically at the same rate from birth to ten or eleven years of age, and the form of their curves of growth is practically the same. There are, it is true, some slight differences to be observed. The Swedish Commission has found that the growing female

†For explanation of this method see Francis Galton's "Natural Inheritance."

**Science*, Dec. 23, 1892, and March 1, 1895.

body reacts more strongly to outward influences that the male, and Schmidt, in his Saalfeld investigation, strongly corroborates this conclusion. He finds that boys grow more regularly than the girls, and this fact is amply borne out by a study of the fluctuations in the charts. However, as a rule, these conclusions apply more particularly to the adolescent period, and it is doubtful that they materially affect the period up to the prepubertal accelerations. These differences are not so significant as materially to modify the statement in its practical import, that children's growth until their eleventh or twelfth year is unsexed. With the beginning of the prepubertal increases and the concomitant changes, which the violent fluxes in height and weight indicate, the statement is reversed. These facts are of the greatest import to the solution of the problem of co-education of the sexes. We may easily conclude, with slight fear of contradiction, that so far as growth by height and weight indicates there is no reason for the separation of the sexes for the first four or five years of school life. Beyond this period there certainly are grave reasons for questioning the system of co-education, upon grounds of physical dissimilarities, not to discuss the mental dissimilarities of girls and boys of the same adolescent age. But the latter period belongs properly to the treatment of the adolescence. On the continent, the rule has been in the past generally in favor of separation, the tendency extending even to the primary classes. A reaction in all countries that have separated primary classes has recently set in, and the tendency toward co-education is extending upward through the grades. Burgerstein† concludes a succinct review of the co-educational problem and the recent reaction against the system in the primary schools: "So far as the data for decision of the question are concerned, the demand for the separation of the sexes has been made and accomplished on *a priori* grounds, but from practical experience the presumptive moral grounds are not as sound as they have hitherto appeared. This is true, at least, for the Volksschulen (primary school)."

Biological Considerations. Little has been accomplished thus far in conforming the phenomena of human growth to biologic laws. The modern theories of Weismann carried to their logical extreme would seemingly place this entire field of anthropometric phenomena in a new light. Dr. C. S. Minot, however, in one or two papers has made a preliminary contribution to this aspect of the problem. He gives to senescence the place of a positive factor which is struggling from birth

†*Handbuch der Schulhygiene*, Burgerstein and Netolitzky, pp. 226-30.

onward with the annabolic or up-building processes. In the earlier period of life, growth has the upper hand — the processes of annabolism do more work than those of senescence, which ever tend to tear down what the other has builded. Growth, Dr. Minot claims, is the product of four factors [68]: The rate of multiplication of cells, (2) the frequency of division, (3) the weight of cells, (4) the loss of cells. In the earlier periods of life, the multiplication of cells, the essential factor of growth, is so rapid that the increment of senescence is less than the increment of the number of cells. "At each division, therefore, the multiplication of the cells obtains the upper hand and the rate of growth increases; soon, however, the increment of senescence surpasses the increment of multiplication, and thereby renders the rate of growth less, until at last the excess of senescence becomes so great that growth ceases, or at least becomes so insignificant that it only serves to counterbalance the loss of cells." Some such principle established and applied to the fluctuations of growth offers a suggestive field of explanation.

The reaction of the reader of this field of investigation must be that of a sense of the extreme complexity of the problems involved. Every result is the product of several factors, and in each community these factors vary at least in the proportion of their mixing. Of the many studies made upon the same or allied problems, there are few that are directly comparable in close detail, so that for conclusions we must content ourselves with expression in the broadest terms until the studies have been so multiplied and repeated under similar conditions that details may be compared. For example, in the matter of the relation of disease to growth, Hartwell in Boston deals with deaths from all diseases, Combe with acute complaints, and Warner with still another classification. The social environment, the school hygiene and climate are varying factors in each case. Moreover, Hartwell's calculations are upon the exact age in years, while Key's ages are obtained largely by averaging ages of the pupils in any school grade. Therefore each study must be taken to a large extent by itself. Further, for the immediate interests of psychology, none of these studies have been carried far enough on psychological lines to satisfy the suggestions which they arouse. We want Dr. Hartwell to tell us the mental condition of these children who died — their relative mental strength compared with those who lived; we want to know from Key, Hertel, Combe and Schmidt-Monnard the mental conditions of those unhealthy school children compared with the healthy ones, so that we may estimate the actual effects and importance of health upon

the mental growth and power; we should like to know the comparative rate of progress of these two classes of children in school—the immediate mental effects of the different diseases upon the nervous system. But Key, Hertel, Hartwell and Schmidt-Monnard are physicians. They have seen these facts from the physician's more or less special standpoint. They have framed their tests accordingly. Is it not the high noon of urgency that the psychologist and pedagogue, from their apperceptive standpoints, were studying these conditions critically, applying their tests and framing courses of practical application? However, on the other hand, while these finer details have not yet been worked out, we are certainly ready to conclude from what all studies unanimously show, that there are rhythms of susceptibility to disease varying with the age of growing children. There are times when the organism is more liable to disease than at others, and the coincidence of these periods with periods of activity and rest in the growth, as shown by height and weight fluctuations, forcibly suggests an organic connection between disease and the growth of specific organs and parts of the body. While it is difficult to trace the details, nevertheless, it seems as though life were a specific thing, and when most active also most tenacious of its prerogatives. Dr. Warner also inclines strongly to the theory of a growth energy, which, when impeded in its natural metabolic functions, expends itself in some other channel, as likely to work harm as good. If this be true, what is the significance to the psychologist and pedagogue? If the function of the pedagogue is to develop the greatest amount of mental strength, then it behooves him to give part of his attention to the duty of obtaining for the nervous system of his pupils their fair share of this vagrant growth energy, so persistently and often mischievously seeking an employer. If disease not only checks nervous growth, but, coming at specific growing periods, permanently dwarfs certain areas of nervous action, then the loss of a Latin root or so is not to be compared with the loss of that which never can be replaced. What may be the factors upon which this development depends? If the body is an autonomous interacting democracy, as up to certain limits we clearly have a right to conclude, we cannot escape the conclusion that in disease of muscular tissue, nervous tissue must in some way be affected. Who can say at present how far-reaching and how permanent may be the effects upon a brain in its nascent period, of an affection outwardly manifested by a simple headache? In Denmark and Sweden we find that between 30 to 75 per cent. of the children in growing ages are affected by chronic diseases alone. In America no such investigation has

ever been made. We have reason to suppose that the percentage must be much less. If true, are the children living in America mentally stronger? Have we a right to give them stronger school work? Can we still lessen the amount of disease, and in how far may we thereby develop men and women stronger intellectually? The study of these facts but starts up suggestions of problems, as sharply important to the parent, pedagogue and psychologist as to the physician. The ground has scarcely yet been broken, and the pioneers who have been cited cannot begin to answer the practical questions of pedagogy and psychology which impatiently demand an answer.

From the studies in nutrition it is shown that the child of favorable conditions, at any given age, is very significantly heavier and taller than the child of unfavorable nutrition and social life. What does this additional height and weight of the favored class signify—merely increments of bone and muscle? Here, then, is unquestionably also a new province for psychology. The anthropometrist has merely given us an unhusked fact, stating that lack of nutrition stunts growth, without telling how much of this loss belongs to muscle, how much to nervous tissue. It is impossible to speculate clearly before we know more of the factors involved, and the psychologist, if he expects psychological results, must take off his coat and investigate for himself. We do not know clearly at what periods of growth effects of mal-nutrition are most pronounced. The evidence wavers between the period before puberty and the period during puberty. If before, what shall we say of possible permanent dwarfing of brain power in that nascent period of rapid growth up to the eighth year, before the brain is said to reach its maximum weight. Roberts has data which seem to indicate that children stunted by unfavorable conditions make permanently smaller men and women. Does this stunting not affect the mental power? This does not mean to imply that small men are mentally duller than big men, for we have seen that there seems to be for every individual his particular size, and to attain which every organism seems to make a significantly desperate struggle. The problem seems, not how to make the child grow big, but how to keep the track clear so that each organism may obtain its particular size. Brer Rabbit, though smaller, is quicker witted than Brer Fox, it is true, but there is no telling how untimely would have been the fate of Brer Rabbit had he been stunted in his early infancy and prevented from reaching his diminutive but particular size. It is a singular fact that the members of the Royal Society of England average taller than any other class of men. Throughout, the professional classes

are distinctly taller than those of the lower classes. What factors are involved? If race is the single factor, then the matter is of least theoretical interest to psychology, but if, as the facts which have been reviewed seem to indicate, nutrition, freedom from accidental disease and social environment are also essential factors, then the facts become of crucial importance to pedagogy and psychology on practical grounds.

Dr. Porter has thrown down the gauntlet resonantly, in the conclusion from his data that among children of the same age, the taller and heavier are more precocious. His facts seem to decide at once that increments of height and weight imply increments of those nervous tissues which make for mental acuteness. Dr. Porter has been sharply reviewed. Dr. West, upon the basis of another test, declares the direct contrary. There are three conclusions involved in the form in which Dr. Porter sums up his evidence: (1) That there is a relation between size and mental activity, (2) that size is the direct causal precedent to mental condition, (3) that large size is the cause of precocity. It is clear at once that the second and third conclusions may be quite wrong, and yet, the first remaining, the data with which he deals are psychological in character. It may be true that Dr. Porter is wrong in finding that precocity accompanies large size—it may be an accompaniment of small size. Or, as Dr. Boas criticises, Dr. Porter may be wrong in concluding that the height and weight are the material causes of mental acuteness, and yet these two effects may proceed from a common cause. It may be, for example, that these precocious children enjoyed better nourishment, and the food supply contributed to build up both muscular and nervous tissues at the most favorable periods and under the most favorable conditions. Or, as Dr. Boas also criticises, the facts Dr. Porter presents may be accounted for on the assumption that children who are taller and heavier are so because they have escaped diseases and the organism has had opportunity for free growth, nervous as well as bony and muscular. But neither criticism vitiates the facts for the psychologist, for both emphasize the importance of the physical conditions of nutrition and freedom of disease as factors directly or indirectly making for intelligence. Dr. West, in his preliminary report upon the Toronto investigation, states that the results are just the reverse of Dr. Porter's conclusion. The large children are duller and the small children more precocious. We have here, then, a direct contradiction, though from the standpoint of different tests.

Dr. Gilbert's studies in Iowa and New Haven and Dr. West's Toronto study are hardly comparable. A teacher's

judgment is as questionable as the test of promotion, and, further, this judgment only speaks for the present. It may be the present is the child's period of rapid growth, or the period of slow growth. Dr. Gilbert and Dr. West should tell us whether, at the time the teacher's judgment is made, the child is growing rapidly or slowly. Dr. West points out that some children enter school a year or two later than usual, and, being older, are therefore taller and heavier, and consequently these children tend to raise the averages of the larger children in each grade. This is undoubtedly a factor of error, but, on supposition, it can hardly be concluded there are so many children who enter school late as to affect all these results so materially as to overthrow them. None of these criticisms can be substantiated by mere argument. We must have duplicate tests made, and tests made from a psychological standpoint with attention to these disputed factors. We need supplementary data on Dr. Porter's study to tell us the age of children entering school, the course of health and nutrition of the large and small classes, the teacher's judgment at periods of rapid growth and periods of slow growth. Not until then can we determine the more exact relations. But this is work for the psychologist. From the standpoint of general experience, it would be singular if Dr. Porter's conclusion is sustained. The stunted tree fruits earlier. The starved street gamin is more precocious than the well-groomed child enjoying four meals a day and growing *ad libitum*. Mr. Bohannon* in his studies of exceptional children finds that large children naturally associate with children older than themselves, and small children with those younger than themselves; it may be consequently that we must reckon with the effects of this factor in considering the precocity of large and small children.

One chief pedagogical problem to be solved is whether children are able to do their best mental work in their growing periods or in their periods of rest from physical growth. We have seen that, on the whole, the period from 6 to 10 or 11 years in girls and from 6 to 12 in boys is a period of general decreases in the rate of growth. Perhaps in the earlier portion of this period, there is a slight increase, but the latter two or three years are undoubtedly one of inactivity of the processes which make for bodily growth. From the prepubertal acceleration in the 11th or 12th to the 15th year in girls and from the 12th or 13th to the 17th in boys, we have tumultuous changes and rapid growth. Now, shall we say with Key and Hartwell that the periods of most rapid growth

**Pedagogical Seminary*, Vol. IV, No. 1 (1896).

are the periods of greatest resistance to disease,—and, inferentially, that the same periods are those in which the child is most active mentally? Shall we say with Porter that the taller and heavier a child is for his age, the brighter he is mentally,—and, inferentially, that the periods of rapid growth are the periods when he is most capable of mental work? If we are satisfied with the evidence and inference, then the period from entrance in school until the prepubertal acceleration is one of comparative mental inertia, while the period of puberty is the time *par excellence* for the strain of school work. Or, from the same data of growth rate, shall we not invoke the theory of compensation and conclude that when the child is growing fastest in bone and muscle tissue, therefore he is resting mentally: that, therefore, the period before the prepubertal increase is the true period for mental activity and the period of active pubertal growth the time for mental rest. A third alternative view is offered by the theory of growth by parts. In the light of this theory, we would conclude that the nervous and muscular systems are to a considerable extent independent systems, and the periods of rest or growth in one have no important and immediate influence upon the other. If we take this view, then we must next consider the growth of the nervous system. This subject must be treated in a subsequent chapter.

Shall we not say in conclusion, then, that this new territory, the problem of growth, is properly a province of psychology? A surgeon's knife and saw have transformed feebly-gifted children into children with normal intelligence. The alienist, from the insane ravings of his patient, has, in some forms of the affection, been able to declare in advance of autopsy the anatomical situation of disease—a lesion in that area, a blood clot in this. The old psychologist is forced to admit that, in certain particulars at least, the physical modifies and conditions the mental, but he hastens to pass by these facts with averted eye as minor details, exceptions, apocrypha, matters for foot-notes and appendices. On the contrary we have before us some vitally important problems in pressing need, upon practical grounds, of early solution. Has the time not come, as when the child, become man, puts away his childish things, so the psychologist may leave to the gymnastic and disciplinary period of his training the old enigmas which require for their solution the complete explication of God and cosmos? Is the time not here when the psychologist may not legitimately push out inquiry into the domain concerned with the modification of the growing mind by sex, race, nutrition, disease, and by rapid and slow rates of metabolism?

BIBLIOGRAPHY.

1. ALLEN, MARY E. The Physical Development of Women and Children. Proc. Am. Assn. of Physical Education, 1890, pp. 9-21.

2. Anthropometry, Papers upon. American Statistical Association, 1894. This pamphlet contains the following articles: (1) A Preliminary Report in Anthropometry in the United States, by Dr. E. M. Hartwell, pp. 1-16; review of the several investigations made in the United States. (2) Remarks on the Theory of Anthropometry, by Dr. Franz Boas; pp. 16-23. (3) On the Application to Individual School Children of the Mean Values Derived from Anthropological Measurements, by the Generalizing Method, by Dr. W. T. Porter, pp. 23-35. (4) Anthropometric Statistics of Amherst College, by Dr. Edward Hitchcock, pp. 35-47. (5) Anthropometrical Study of the Effects of Gymnastic Training on American Women, by C. J. Embuske, Ph. D. (pp. 47-58). (6) Growth of St. Louis Children, by Dr. W. T. Porter, pp. 58-65; reviewing his previous study of the same title (Bib. No. 78). (7) Growth of Children, by Dr. H. P. Bowditch, pp. 65-116; a reprint of his article in the Eighth Annual Report of the Massachusetts Board of Health (Bib. No. 18).

3. BAXTER, DR. J. H. Statistics, Medical and Anthropological, of the Provost-General's Bureau, derived from records of the examination for military service in the armies of the United States during the late War of the Rebellion, of over a million recruits, compiled under the direction of the secretary of war. 2 vols. Washington, 1875.

4. BEDDOE, DR. Stature and Bulk of Man in the British Isles, London, 1870.

5. BERNARD, P. Considérations médico-légales sur la taille et le poids depuis la naissance jusqu'à l'âge adulte. *Archiv. d'Anthropologie Criminelle.* Tome II, pp. 213-25. Paris, 1887.

6. BERTILLON, A. Les Proportions du Corps Humain. *Revue Scientifique.* Tome XLIII, pp. 524-529.

7. BERTILLON. La Taille en France. *Revue Scientifique.* Tome XXXVI, pp. 481-8.

8. BERRY, J. J. The Physical Basis of Crime. Medical Age. Vol. XIV, pp. 72-77, 1896.

9. BEYER, DR. H. G. Observations on Normal Growth and Development under Systematized Exercise. Report of the chief of the Bureau of Medicine and Surgery to the secretary of the navy. Washington, 1893. p. 141-60.

10. BEYER, DR. H. G. Growth of U. S. Naval Cadets. Proc. U. S. Naval Institute. Vol. XXI, No. 2.

11. BOAS, DR. FRANZ. On Dr. William Townsend Porter's Investigations of the Growth of the School Children of St. Louis. *Science,* March 1, 1895.

12. BOAS, DR. FRANZ. Anthropological Investigations in Schools. *Pedagogical Seminary.* Vol. I, pp. 225-8. (A review of the subject.)

13. BOAS, DR. FRANZ. Growth of Children. *Science,* Dec. 23, 1892.

14. BOAS, DR. FRANZ. Growth of First-Born Children. *Science.* N. S., I, pp. 402-4.

15. BOAS, DR. FRANZ. The Forms of the Head as Influenced by Growth. *Science,* 1896. N. S., Vol. IV, pp. 50-1.

16. BOAS, DR. FRANZ. An article upon Growth of American Children. Report of the U. S. Commissioner of Education, 1896-7.

17. BOULTON, DR. Some Anthropometrical Observations. *British Medical Journal*, March 4, 1876. pp. 280-2.
18. BOWDITCH, DR. H. P. The Growth of Children. Eighth Annual Report of the State Board of Health of Massachusetts. Reprinted in Papers on Anthropometry by the American Statistical Association. The data of this study in original form were collected in the public schools of Boston and vicinity and from a few private schools. About 24,500 children, girls and boys, were thus studied. Numerous tables and charts present the material in various forms, and the paper, though the first dealing with large numbers, is as complete in data and discussion of the subject of height and weight as any that have since been issued. The method of investigation is described, and comparative growth is separately discussed with reference to sex, race, age, environing conditions. The tables are arranged to show growth when both parents are American, both Irish, one American and one Irish, both German, one or both English. Fifteen plates in conclusion show by curves the facts of the tables.
19. BOWDITCH, DR. H. P. The Growth of Children. Tenth Annual Report of the State Board of Health of Massachusetts, pp. 35-62. This constitutes an investigation supplementary to the first investigation, and deals more directly with the problems of the relative importance of mode of life and of race in determining the size of growing children. It contains eleven tables and eleven plates. The first nine tables segregate the data of the first investigation into classes; first of races, American and Irish, and then under each of these titles, the children of parents whose occupations are professional, mercantile, skilled labor, and unskilled labor. The sexes are, of course, separated. The last two tables deal with occupations of parents, irrespective of nationality, giving the heights and weights of the children of the laboring and non-laboring classes, males and females. The plates give the growth of each of these classifications in graphic form.
20. BOWDITCH, DR. H. P. The Growth of Children Studied by Galton's Percentile Grades. Twenty-second Annual Report of the State Board of Health of Massachusetts (1890), pp. 479-525. The data of the article in the Eighth Report (No. 18) are here rearranged under the Galton system and tables in accordance with this present method. It contains thirteen plates and seventeen tables. The chief contribution of this study is that children, heavy and tall for their age, reach the prepubertal acceleration earlier than smaller children of the same age. This principle is discussed and illustrated in detail.
21. BOWDITCH, DR. H. P. An Article upon Growth with Reference to Discease. Trans. American Med. Assn., Vol. XXXII, pp. 376; 1881.
22. CAMERER, DR. W. Bemerkungen über Wachstum; Zts. f. Biologie, 1880, pp. 24-28. The article contributes to literature of infant growth. Another contribution to the same field by the same author is to be found in Jahrb. f. Kinderheilkunde, 1882, p. 254. The important data of both these articles will be found in the contribution in 1893 (Bib. No. 23), which follows.
23. CAMERER, DR. W. Untersuchungen über Massenwachsthum und Längenwachstum; Jahrb. f. Kinderheilkunde, Bd. XXXVI, pp. 249-93, 1893. Dr. Camerer has herein given the most complete contribution to the literature of infantile growth, periods of rapid and slow increases, and the effects of different forms of nourishment, breast (mother and nurse) and artificial. He also carefully reviews, in relation to his own conclusions, those of other contribu-

tors to this field: Russono, Fleischmann, Vierordt and Malling-Hansen. Among his more important tables are the following: Weekly average weights for the first year of fifty-seven infants nourished by mother's or nurse's milk, of thirty-one infants with artificial nourishment; twenty-eight infants upon a mixed diet of woman's milk and artificial food; average yearly growth in height of a few children, arranged according to social classes of three or four, for the period from birth to maturity; daily fluctuations in weight of individuals of different ages; weights of about sixty individual children for the first year of life under different forms of nourishment specifically stated for each.

24. CARSTÄDT, DR. FRITZ, Rektor der evang. Höheren Bürgerschule I in Breslau. Ueber das Wachstum der Knaben vom 6 bis zum 16 Lebensjahre. Zeitschrift für Schulgesundheitspflege, 1888, pp. 65-74. Dr. Cärstadt deals exclusively with the height of boys and a table gives semi-annual measurements from the 6th to the 16th year inclusive, covering 4274 measurements; the average heights and the increase for each half year are recorded. A second table gives the maximum and minimum heights, semi-annually, and the amount of difference. The discussion is limited to explanation of the tables and inferences from them.

25. COMBE, DR. MED. Schularzt und Privatdocent der Kinderheilkunde an der Universität Lausanne. Körperlänge und Wachstum der Volksschulkinder in Lausanne. Zeitschrift für Schulgesundheitspflege, 1896, pp. 569-589. The virtue of this study is that it is largely upon the "individual" plan, and the exact age of the children is represented. Beginning with 1886 the pupils, girls and boys, of the Volksschulen of Lausanne were each provided with individual cards, giving the data of birth, class in school, data of measurement. The children were measured during November of each year, and each measurement entered upon this card. At the end of seven years these cards were collated, and Dr. Combe's paper deals with the study of them. There were in all 13,358 measurements; 6,662 of boys and 6,696 of girls, representing about 2,000 individual children. The measurements are from the 7th to the 14th years inclusive. A table of "monthly averages" for each sex gives in separate columns the growth of those whose birthdays fell in November, those who were so many years and one month old, so many years and two months, and so on up to twelve months. Tables of yearly averages are also given and a diagram indicating the growth of each sex for the 9th to the 17th year inclusive. Dr. Combe discusses at length the value of this method of measurement, disease in relation to growth in height at different ages, increases, the absolute height with reference to the time of birth in the year, and the relation of height and increase to children in different countries.

26. COWELL. Parliamentary Reports, 1833, XX., DI., p. 87.

27. DAFFNER, F. Vergleichende Untersuchungen über die Entwickelung der Körpergrosse und des Kopfumfanges. Archiv. f. Anthropologie, XV, pp. 37-44, 1884. Dr. Daffner's study deals with the relation of height of body in infants and young children (chiefly up to 7 years of age) to the circumference of head. His tables give maximum, minimal and average measurements of about 425 boys and 375 girls.

28. DAFFNER, F. Ueber Grösse, Gewicht, Kopf und Brustumfang beim männlichen Individuum vom 13 bis 22, Lebensjahre. Archiv. f. Anthropologie, XV, supplement, pp. 121-6. In this contribution Dr. Daffner compares the height, weight, breast circumference and head circumference of males from 13 to 22 years. His data, however, are obtained from small numbers—from six to forty-one for each age up to 21 years.

29. DONALDSON, H. H. Growth of the Brain. New York, 1895.
30. D'ELSÄSSER. Henke's Zeitschrift. Vol. XLII, p. 238.
31. ERISMANN, DR. FR. Professor of Hygiene an der K. Universität in Moskau. Die Schulhygiene auf der Jubiläumsausstellung der Gesellschaft für Beförderung der Arbeitsamkeit in Moskau. Zeitschrift für Schulgesundheitspflege, 1888, pp. 347-373; 393-419. The report deals with general hygiene, but in the latter part gives some important comparative tables and discussion upon height, weight, and breast circumference of about 3,000 boys and 1,450 girls of the Moskau city school, 4,300 boys and 700 girls in village schools, and (in height and breast circumference) of 16,988 boys and 14,382 girls of the factory classes, ages 7 to 17 or 18 years.
32. D'ESPINE UND PICOT. Grundriss der Kinderkrankheiten, 1878.
33. EVETZKY, DR. *New York Medical Journal*, February, 1881.
34. FARR, W. Table showing the relative statures of boys at the age 11 to 12, under different social and physical conditions of life. Report of British Association for Advancement of Science, 1880. Also table showing the actual average and mean height of 10,651 boys and men between the ages of 10 and 50 years. Report of British Association for Advancement of Science, 1880.
36. FLEISCHMANN, DR. LUDWIG. Ueber Ernährung und Körperwägungen der Neugebornenen und Säuglinge, 1877.
37. GALTON, FRANCIS, Chairman. Report of the Anthropometric Committee of the British Association for 1883. This is also bound in the same volume with Roberts' Anthropometry. The committee was appointed in 1875, making a yearly report in each of the five years, 1878-82, and this is its final report. The subjects investigated are stature, weight, girth of chest, complexion, breathing capacity, strength of arm, sight, span of arms, size and shape of head, length of lower limbs as shown by the difference between the sitting and standing positions. The report contains a mass of data upon adults of England, but devotes considerable space to the period of growth. Tables are given of the height and weight of 451 boys and 466 girls at birth; also tables of the stature and weight of about 60,000 males of all ages, and of about 8,000 females, residents of Great Britain; also tables of growth of industrial school and factory children; general conclusions upon the growth of children.
38. GALTON, FRANCIS. On the Height and Weight of Boys, Aged 14 Years, in Town and Country Public Schools. *Journal of the Anthropological Institute of Great Britain and Ireland*, Vol. V, pp. 174-80, 1876.
39. GALTON, FRANCIS. Hereditary Stature. *Journal of the Anthropological Institute of Great Britain and Ireland*, 1885-6; pp. 488-99.
40. GALTON, FRANCIS. Why do We Measure Mankind? *Lippincott's Magazine*, February, 1890.
41. GALTON, FRANCIS. Family Likeness in Stature. Proc. Royal Society, London, 1886; pp. 42-73.
42. GEISSLER, DR. MED. ARTHUR, UND UHLITZSCH, RICHARD. Die Grössenverhältnisse der Schulkinder im Schulinspektionbezirk, Freiberg. Zeitschrift des K. Sachsischen Statistischen Bureaus, XXXIV Jahrgang, 1888. Heft I-II, pp. 28-40. This represents a study begun in 1886 by Herr Schulrath Lohse in the school inspection district of Freiberg, in order to determine the fitting of school desks. It was completed by the authors named. In all, 21,173 children from 6½ to 14½ were measured — 10,343 boys and 10,830 girls. There are given tables and discussions of the heights of the children by sex and age, the maximal and minimal limits, the arithmetical aver-

ages, grouped by ages according to height. A comparison is made between the heights at the different ages of the children in the Freiberg Bürger school and those of the peasant classes in the outlying towns and the results showing a greater average height of the former at a given age, are given in tables and also graphically. In addition there is a careful mathematical study of the probable error involved, concluding that the arithmetical average is not suitable for practical application and offering a formula for correction.

43. GEISSLER, DR. MED. ARTHUR. Medezinalrat in Dresden. Messungen von Schulkindern in Gohlis-Leipzig. Schulgesundheitspflege, 1892, No. VI, pp. 249-253. The study deals with the height of 2,806 children, 1,386 boys and 1,420 girls; and the weight of 2,802 children, 1,385 boys and 1,417 girls. The investigation was undertaken at the close of the summer vacation in 1889. He discusses the difference between children of the favored and unfavored classes, giving brief data.

44. GILBERT, J. ALLEN. Researches on the Mental and Physical Devolopment of School Children. Studies from the Yale Psychological Laboratory, Vol. II, 1894, pp. 40-100. The matters experimentally investigated are as follows: muscle sense, sensitiveness to color differences, force of suggestion, voluntary motor ability, fatigue, weight, height, lung capacity, reaction time, and time memory, precocity and dullness. The children measured were New Haven (Conn.) children, 6 to 17 years inclusive; 602 boys and 584 girls. Approximately fifty children of each sex and for each age were thus tested. Shoes were worn. Dr. Gilbert's tables give the heights, both in centimeters and inches; the columns give weight of both sexes; statistical mean variation for the same; height of boys for each age; statistical mean variation for boys; height of girls for each age; statistical mean variation for girls; height of children denominated "bright" by their teachers; height of children denominated "average" and height of children termed "dull;" and also the number of each sex at each age. Two curves are separately charted; first, the curve of growth by girls and boys and by each sex separately; secondly, the statistical mean variation for both sexes and then each separately. The tables for the other tests give about the same detail.

45. GILBERT, J. ALLEN. Researches upon School Children and College Students. University of Iowa Studies in Psychology, Vol. I, pp. 1-39. Dr. Gilbert repeats upon pupils in Iowa schools and students in the University of Iowa some of the experiments performed upon New Haven children, as stated in No. 44. Some new lines of investigations are worked out; the data upon dull, mediocre and precocious children are much fuller. The tests taken are as follows: (1) pulse, both before and after the series of tests; (2) pain threshold; (3) strength of lift with the wrist; (4) strength of lift with the arms; (5) estimation of length by arm movement; (6) estimation of length with the eye; (7) lung capacity; (8) weight; (9) height; (10) voluntary motor ability. The number of subjects is approximately fifty at each age for each sex. Tables segregated for age and sex, and curves for both the experiment itself and the mean variation of both sexes are given for each test. All tables segregate the dull, mediocre and precocious children, so that comparison is easy. The curves for dullness and precocity are also given in the cases of weight, height, lung capacity, voluntary motor ability and fatigue.

46. GOULD, B. A. Investigations in the Military and Anthropological Statistics of American Soldiers. U. S. Sanitary Commission, N. Y., 1869.

47. GREENWOOD, J. M. Heights and Weights of Children. Report of Board of Education of Kansas City Schools, 1890-91; American Public Health Association Reports, Vol. XVII, pp. 199-204.

48. HALL, WINIFRED S., PH. D., M. D. Changes in Proportions of the Human Body During the Period of Growth. *Journal of Anthropological Institute of Great Britain and Ireland*, Vol. XXV, 1895, pp. 21-46. Dr. Hall was medical examiner at Haverford College, 1889-93, and also examined the boys of three Friends' grammar schools. The data present great homogeneity as to race, nationality and social conditions. The ages concerned are from 9 to 23 years. The measurements taken are: height; height of hip, knee; girth of head, neck, chest at nipples, ninth rib, abdomen; circumference of hips, thigh, knee, calf, ankle, upper arm, elbow, ankle, forearm, wrist; depth of chest, abdomen; intercranial breadth; length of upper arm, forearm, hand, foot; weight (nude); lung capacity; strength of back, thigh, pectoral muscles, forearm, upper arm. Important conclusions are reached relative to strength.

49. HANSEN. Ueber die Individuellen Variationen der Körper Proportionen. Archiv. f. Anthrop., Bd. XX, p. 321.

50. HARTWELL, E. M. Report on Physical Education in the Boston Public Schools, 1894.

51. HERTEL, DR. AXEL. The Danish Commission was appointed in 1882 and investigated the health of 17,595 boys and 11,646 girls, partly in the higher schools, partly in Volksschulen, both in Copenhagen and in the country. The matters considered were: age, length of work, time at school and at home, height, weight, and diseases, chiefly scrofula, anæmia, nervousness, headache, nosebleed, chronic indigestion, chronic lung and heart complaints, spinal curvature, and other chronic diseases such as those of the kidneys, joints, etc. Since both higher and Volksschule pupils were investigated, the report treats of the effects of social environment. The results of this commission, those of the Swedish Commission, and of his own are reviewed and discussed by Hertel.

52. HERTEL, DR. AXEL. In 1881 Dr. Axel Hertel, Kommunaler Kreisarzt in Kopenhagen, published (in Danish) a report of an examination of growth he had made upon 3,141 boys and 1,211 girls, all pupils in the higher schools of Copenhagen. The report showed the growth and prevalence of chronic diseases among children for different ages. The information was obtained from the parents and family physicians. The results of this study will be found briefly reviewed in an article by Dr. Hertel (see No. 53). An English translation of Hertel's book by Godfrey Sörenson is published by Macmillan, 1885, under the title of "Overpressure in High Schools of Denmark."

53. HERTEL, DR. AXEL. Neure Untersuchungen über den Allgemeinen Gesundheitszustand der Schuler und Schulerinen. Schulgesungheitspflege, 1888, Nos. 6 and 7, pp. 167-183; 201-215. This is a review and comparison of the result of his own, of the Danish Commission's and the Swedish Commission's investigations upon the age, height, weight, and chronic diseases of children between 6 and 17 years of age. He charts the curves of the per cents. of diseases at various ages, and discusses the results in their relation to age, physiological conditions, school and home duties. In the second article he gives the chief tables of the two commissions and discusses the problem of school hygiene from this standpoint. The most important contributions of the Danish and Swedish Commissions are here reviewed, and the most valuable of the tables are reproduced.

54. HESS, W. Bestimmungen des Gewichtes und Messungen

der Körperlänge bei einem Kinde im ersten und zweiten Lebensjahre. Archiv. f. Gynækologie; Berlin, 1881.

55. HITCHCOCK, E. Physical Education, London, June, 1891.

56. HOLMES, B. Study of Child Growth. *Intelligence*, Vol. XIV, p. 323.

57. HUDSON, G. H. Phenomena of Child Growth in Education. *Education*, Vol. XIV, p. 466.

58. KEY, AXEL. Läroverkskomiténs Betänkande III. Bilage E. Kongl. Boktryckeriet. Stockholm, 1885, 2 vols. The work is edited in German, somewhat condensed, by L. Burgerstein, under the title, "Schulhygienische Untersuchungen, Hamburg and Leipzig, 1889." This constitutes the report of the Swedish commission of which Axel Key was the head, appointed in 1882 by the government to investigate the hygienic conditions of the schools. The report deals with data from 15,000 boys of the Swedish middle schools and 3,000 girls in private schools. The original contains a volume exclusively devoted to elaborate tables and curves. The greater portion of the report is occupied by hygienic investigations, short-sightedness, influence of work upon health, possibilities of instruction, sleep, relation between health and hours of sleep, conditions of home surroundings, etc. A chapter, however, is devoted to the development in length and weight at different ages from 6 to 20, boys and girls. The most signal contribution of the report is that showing the relation of disease to the periods of rapid and slow growth. The results of the Swedish commission are compared and discussed by Dr. Axel Hertel. (See No. 53.)

59. KEY, AXEL. Die Pubertäts Entwickelung, Verhandl des Internat. Med. Congress zu Berlin, Bd. I, 1890, p. 67 *et seq.*

60. KOTELMANN, DR. L. Med. u. Phil. Die Körperverhältnisse der gelehrten Schüler des Johanneums in Hamburg. Zeitschrift des Königlichen preussichen statistichen Bureaus, Jahrgang, 1879. This is a very careful study upon 515 boys, 10 to 15 years of age, giving accurate data upon growth in height, weight, strength, lung capacity, vital force, etc.

61. VON LANGE, EMIL. Die Normal Körpergrosse des Menschen, München, 1896.

62. LIHARZIK, F. Das Gesetz des Wachstums und der Bau des Menschen, etc., Vienna, 1862.

63. LANDSBERGER, DR. Prakt. Arzt in Posen. Das Wachstum im Alter der Schulpflicht. Archiv für Anthropologie, Vol XVII, pp. 229-264. This is a study upon the individual plan. Dr. Landsberger measured a number of children from 1880–1886, partly of German and partly of Polish parentage, partly of the favored class and partly of the poorer classes. There were originally 104 children, but the number fell off from year to year, and in 1886 there were but thirty-seven remaining. The measurements are from 6 to 13 years of age. In addition to height there were twenty-four other measurements: Distance from finger-tip to finger-tip with arms outspread, height of left shoulder, right shoulder, middle finger-tip, height of hip bone and of knee, length and width of skull, circumference of neck, length of breast bone, circumference at breast, circumference at navel and others. He discusses the differences in height relative to race, obtaining negative results; with reference to effects of nutrition, disagreeing with Bowditch that race is a more important factor than nutrition. A table at the close gives in detail the measurements by years. Each series of measurements is discussed with care and in comparison with the results of other investigators.

64. MALLING-HANSEN, P. Perioden im Gewicht der Kinder und in der Sonnenwärme, Kopenhagen, 1886. The contents of this book

are summarized in this article. An accompanying volume of charts illustrates graphically the tables of growth.

65. MALLING-HANSEN, PASTEUR R., Directeur de l'Institution. Einige Resultate der täglichen Wägungen von 130 Zöglingen des Köngl. Taubstummen-Instituts in Kopenhagen. Congrès Périodique International des Sciences Médicales. Copenhagen, Vol. III, pp. 103–119. The first portion of this address covers the matter of seasonal periods and weekly, more extensively and carefully treated in his later publication (No. 64). The latter part deals with an experiment upon a change of diet in the institution, and shows the effect of good nutrition and the fact that improved food affects growth in weight only at certain definite times of the year. The facts are graphically illustrated by nine charts.

66. MALLING-HANSEN, PASTEUR R. Ueber Periodicität im Gewicht der Kinder an Täglichen Wägungen. Fragment I, Kopenhagen, 1883, p. 35. This monograph is a brief preliminary report upon the observations more extensively treated in No. 64. It deals chiefly with the seasonal periods of growth, the daily variations due to atmospheric temperature.

67. MEEK, K. Volummessungen des Menschlichen Körpers und seiner enizelnen Theile in den verschieden Alterstufen. Zts. f. Biologie. München und Leipzig, 1894, pp. 125–47.

68. MINOT, DR. C. S. An article in Harvard Medical School Laboratory Papers (1873–9) upon the biological factors of growth.

69. MINOT, DR. C. S. Human Growth, *Boston Medical and Surgical Journal*, July 22, 1880.

70. MINOT, DR. C. S. Senescence and Rejuvenation. *Journal of Physiology*, Vol. XII, pp. 97–153, 1891.

71. MIWA, NORIHIVA, M. D. A study upon weights from 3 to 80 years of age. *Tokio I-Gaku-Kwai-Zatumshi*, Vol. VII, No. 9 (May 5, 1893), Japan.

Dr. Miwa gathered data from the kindergartens, higher schools, colleges and other sources. He deals with the problem of maturity in growth, and also, to a limited extent, with the weights of different classes of society. In the tables given the number of persons examined is generally from 150 to 230 for ages between 6 and 20 years.

72. MOON, S. B. Measurements of the boys of the McDonough School, for years 1888–91. McDonough School, Maryland, 1892.

73. MOULTON D. Body Weight and Mental Improvement, *American Journal of Insanity*, October, 1894.

74. PAGLIANI. Die Entwickelung des Menschen in den der Geschlechtsreife vorangehenden späteren Kinderjahren und in Jünglingsalter von 7 bis 20 Jahren. Other publications by Pagliani are not available, except in Italian (for titles, see bibliography given by Dr. Porter, Growth of St. Louis Children). Pagliani investigated the height, weight, lung capacity and muscular force of children, boys and girls, 7 to 18 years of age, of Turin, Italy. He considered the effects of good and poor nutrition, giving tables of rate of growth of school girls under favored conditions and corresponding facts concerning a number of charity girls. He also gives statistics upon the effects of exercise upon the development of lung capacity of boys.

75. Oakland (Cal.) School Report, 1892–93. In 1892 about 6,000 children, 6 to 18 years, were weighed and measured under the direction of the University of California and Stanford University. A part of this data was collated. The study is in reprint form and gives tables and graphic charts of height and weight.

76. PECKHAM, GEO. W., M. D. The Growth of Children. Sixth

Annual Report of the State Board of Health of Wisconsin. The study was undertaken in 1881 in the public and various private schools of Milwaukee. It consists of data of about 10,000 children, from 4 to 18 years, arranged much on the same plan as that of Dr. Bowditch's study (No. 18). There are eleven plates and thirteen tables segregating the rates of growth by nationalities. Among the topics treated is that of the relative reliability of the arithmetical averages and medium values, variations of growth by influences of sex, race, climate, density of population, relation of growth of body and lower extremities.

77. PORTER, W. T. Relation of Growth of Children and their deviation from the physical type of their sex and age. Trans. Acad. Sci. of St. Louis, Vol. VI, No. 10, 1893.

78. PORTER, DR. WILLIAM TOWNSEND. Growth of St. Louis Children. Issued as a report of the Academy of Science of St. Louis, Vol. VI, No. 12, pp. 263-380. This is the result of the study of 34,354 children; 16,295 boys and 18,059 girls of St. Louis, taken in 1892. It embraces data of age, sex, occupation and nationality of parents, height standing, weight sitting, span of arms, strength of squeeze, girth, weight, measurements of face and head. The first portion of the report is occupied with a statement and discussion of the statistical methods employed and mathematical consideration of probable error, the median or average, etc. Among the many subjects treated are: The influence of occupation and nationality of parents, sexual differences of growth, application to individual children of the mean values. There are fifty-one tables largely in percentile grades and thirty-four plates illustrating graphically the facts shown by the tables. An index and a comprehensive bibliography are inserted.

79. PORTER, DR. W. TOWNSEND. The Physical Basis of Precocity and Dullness. Transactions of the Academy of Science of St. Louis, Vol. VI, No. 7, pp. 161-181. Reprint issued March 21, 1893. The conclusions of this study are derived from the date of Dr. Porter's Growth of St. Louis Children (see No. 78), and is, therefore, based upon investigations of 34,500 boys and girls, 6 to 17 or 18 years of age. The thesis he advances with much certainty is that "precocious children are heavier and dull children are lighter than the mean child of the same age." For the purpose of establishing this principle he gives fifteen tables and two plates tracing the development by age of dull, mediocre and precocious boys and girls.

80. QUETELET, A. Anthropometrie. Brussels, 1870. The data of Quetelet are inserted merely for their historic value and for reference. They have little scientific value, physiological or statistical, since they are averages from but ten individuals of each age and these were first "selected."

81. RÄTZ. Grundzüge d. Physiologie; Pathologie und Therapie des Kindesalters, 1883, p. 22 (deals with growth from birth to sixth year).

82. ROBERTS, CHARLES, F. R. C. S. Manual of Anthropometry. London, 1878. This is probably the most general and complete treatment of growth measurements in English. It deals with the methods of anthropometric study and apparatus; and contains numerous tables and an excellent bibliography up to the date of publication. Among the more important tables are those showing the height, weight, and annual rate of growth of 7,709 boys and men between the ages of 10 and 30 years of the most favored classes of the English population, public school boys, naval and military cadets, medical and university students; a similar table showing the empty chest girth of 5,915 boys and men, 12 to 30 years, of the

same class; a table showing the height, weight and chest girth of new-born infants of the artisan class; tables of actual, average and mean height, weight and chest girth of 13,931 boys and men between the ages of 4 and 50 years of the artisan class; a table from Dr. Bowditch of Boston showing the actual, mean and average weight of 10,904 American girls between 5 and 19 years; tables giving the average height and weight of 54,447 boys and men of all ages to 50 years, English population segregated according to classes as follows: professional, commercial, laboring, industrial, idiots and imbeciles, also the same data for 4,630 Boston boys from the favored class quoted from Dr. Bowditch. All of these tables segregate the data according to age. The volume also contains plates, charting certain facts given in the tables, and also one charting the relative growth from year to year of the different parts of the body, head, neck, chest, abdomen, thigh, leg and foot.

83. ROBERTS, CHARLES, F. R. C. S. Memorandum on the Medical Inspection of, and Physical Education in, Secondary Schools. Report of the Royal Commission on Secondary Education of England, Vol. V, p. 352-374. The report deals chiefly with hygiene, death rates at various ages, size in relation to intelligence, weight, height, physical education, etc.

84. RUSSOW, A. Vergleichende Beobachtungen über den Einfluss der Ernährung mit der Brust, u. d. Kunstlichen Ernährung auf das Gewicht und Wuchs (Länge) der Kinder. Jahrb. f. Kinderheilkunde, Vol. XVI, pp. 86-132, 1880-1.

85. SCHMIDT, EMIL. Die Körpergrösse und das Gewicht der Schulkinder des Kreises Saalfeld (Herzogthum Meiningen). Archiv. f. Anthropologie, Vol. XXI, pp. 385-434 (1892-93). In the city of Saalfeld on June 1, 1889, 9,506 children, 4,699 boys and 4,807 girls, from 5 to 14 years, were measured and weighed. Herr Schmidt devotes much space to comparing these heights and weights with the results of other studies, those in Freiburg, Gohlis, Posen, Breslau, Hamburg, Boston, England and Turin; a second part is taken up with a comparison of the children of Saalfeld city with those in the outlying country, data of which are given; a careful study in detail is also made of each district. The study is replete with tables.

86. SCHMIDT-MONNARD, KARL. Die chronische Kränklichkeit in unseren mittleren und höheren Schulen; XII internationalen Med. Kongress zu Moskau, 1897; also Zeitschrift f. Schulgesundheitspflege, 1897, Nos. 11 and 12, pp. 593-620, 666-685. Dr. Schmidt-Monnard has in this study made a valuable and elaborate contribution to the literature of hygiene of the middle and higher schools from data he has collected in Halle. He investigated 5,100 boys and 3,200 girls in the higher and middle schools, relative to the prevalence of chronic diseases, headache, nervousness, chlorosis, sleeplessness, indigestion, loss of appetite, nose bleed and eye troubles. He considers the problem of sex, finding boys less susceptible to disease than girls; the conditions of various classes of school, the hygiene of their requirements and the data class by class; effects of home duties; the amount of sleep at various ages, effects of fatigue observed. He gives a number of charts, and a few tables, some of which deal with effects of vacation colonies and the growth in height and weight of individual children through the 14th year.

87. SHUTTLEWORTH, DR. G. E. The Health and Physical Development of Idiots Compared with Mentally Sound Children of the Same Age. Proc. of Association of Medical Officers of American Institutions for Idiotic and Feeble-minded Persons, 1876-86, pp. 315-322.

88. SULIGOWSKI, DR. FELICYAN. (Anthropometric measurements of children in the gymnasium for boys at Radom, Russia.) Medycyna, Tome XV, p. 512. Warsaw, 1887. Dr. Suligowski gives data upon 1,133 males, 9 to 21 years of age. The investigation deals with statistics upon height, weight, expansibility of the chest, power of sight, color of hair, traces of crookedness on the breast, increase of lymphatic tonsils on the neck.

89. TARBELL, DR. G. G. On the Height, Weight and Relative Rate of Growth of Normal and Feeble-minded Children. Proceedings of the Association of Medical Officers of American Institutions for Idiotic and Feeble-minded Persons, 1876-86.

90. TOPINARD, PAUL. Etude sur la Taille, considérée suivant l'âge, le sexe, l'individu et les races.

91. TOPINARD, PAUL. Anthropology translated by R. T. H. Bartley, M. D. Philadelphia, 1878.

92. VAHL, DR. M. (Director of the Girls' School of Jägerpris in Denmark.) Mittheilungen über das Gewicht nichterwachsener Mädchen. Congrès Périodique International des Sciences Médicales, Copenhagen, 1884, pp. 120-125. The school is for poor girls. The children vary in age from 4 to 16 years. They were weighed twice a year from 1874 to 1883, on April 1 and October 1. Tables are given of the yearly and half yearly weighings, and the increases, showing a larger growth in the summer half year than in the winter half year. A brief statement of his results with table will be found in the Burgerstein-Key Hygienische Untersuchungen, pp. 244-245 (No. 58).

93. VIERORDT, K. Physiologie des Kindesalters; Gerhardt's Handbuch der Kinderkrankheiten, Bd. I, pp. 228-36.

94. VIERORDT, K. Anatomische, Physiologische und Physikalische Daten u. Tabellen.

95. VIERORDT, K. Grundriss der Physiologie des Menschen. Tübingen, 1871.

96. VILLERME. Annales d'Hygiène, Vol. I, p. 359.

97. VOIT, DR. C. Ueber die Periodicität im Gewicht der Kinder, 1885.

98. WARNER, DR. FRANCIS. Report to the British Medical Association and Charity Organization Society of London on the Physical and Mental Condition of 5,000 Children seen in 106 Schools of London. Reprinted in the Report of the Commissioner of Education (U. S.), 1890-1, Vol. II. See also Bibliography No. 109.

99. WARNER, DR. FRANCIS. Study of Children, 1897.

100. WARNER, DR. FRANCIS. A Method of Examining Children in Schools as to their Development and Brain Condition. *British Medical Journal*, Sept. 22, 1888.

101. WEST, GERALD M. Worcester School Children, the Growth of Body, Head and Face. *Science*, Vol. XXI, Jan. 6, 1893. The investigator weighed and measured 3,250 individuals, 5 to 21 years, in the public and private schools of Worcester, Mass. He gives curves (not tables) and discussion of weight, height, width of head, length of head, sitting height, index of sitting height, proportion of breadth of face to breadth of head, etc.

102. WEST, GERALD M. Anthropometrische Untersuchungen über die Schulkinder in Worcester, Mass. Archiv. f. Anthropologie, Vol. XXII, pp. 13-48, 1894. The study here detailed is a much more complete report than that given in *Science* (No. 101), though dealing with the same topics. There are given twenty-one tables and five chart curves.

103. WEST, GERALD M. Observation of the Relation of Physical Development to Intellectual Ability Made on the School Children

of Toronto, Canada. *Science*, N. S. IV, 1896, pp. 156-159. This is a preliminary report to a contribution not yet completed. The writer discusses the conclusion of Dr. Porter in St. Louis that children taller and heavier are more precocious than their lighter and shorter fellows of the same age. He reaches a diametrically opposite conclusion. The basis for determination of precocity is the teacher's judgment, while in St. Louis the basis was the school grade in comparison with age. Dr. West gives no figures, but a curve showing the relative size of "good" and "poor" students.

104. WEST, GERALD M. Address in Proceedings of the International Congress for Anthropology, Chicago, 1893.

105. WIENER, DR. CHRISTIAN. Das Wachstum des menchlichen Körpers (in Vorträge Gehalten im Naturwissenschaftlichen Verein zu Karlsruhe). Karlsruhe, 1890. This is abrief monograph giving the yearly heights and head measurements of Dr. Wiener's four sons from birth to maturity. Tables and curves are furnished and it forms a contribution of its kind of great value.

106. WINDLE, B. C. A. Anthropometric Work in the Schools. *Medical Magazine*, London, 1894, pp. 631-649.

107. WRETLIND has weighed the pupils of the girls' school in Gothenberg (Denmark) at the beginning and end of the school year (September and June). His results were printed at Eira in 1878, in Danish. A review of essential results and tables will be found in the Burgerstein-Key Schulhygienische Untersuchungen, pp. 240-242 (No. 58). Wretlind attempts to show that school work retards growth.

108. ZACHARIAS, O. Ueber Periodicität in der Gewichtzunahme bei Kindern; Monatl. Mitth. a. d. Gesamtgeb. d. Naturw. Berlin, 1889.

109. Report on the Scientific Study of the Mental and Physical Conditions of Childhood; with particular reference to children of defective constitution, and with recommendations as to education and training; based upon the examination of 50,000 children seen in 1888-91 and another 50,000 seen in 1892-4; published by the Committee. Parkes Museum, Margaret street, W., London; 1895.